Digital Reconstruction - Final Report

Monday, 13 June 2022 Version 1.2r

On behalf of the Sheku Bayoh Inquiry

SHEKU BAYOH INQUIRY

ABOUT US

Advanced Laser Imaging Ltd formed in late 2013 and specialise in the 3-Dimensional recording of objects and locations for the purposes of conducting accurate spatial analysis. They use a range of specialist survey equipment including Laser Scanners to rapidly survey a scene and produce a 1:1 virtual reconstruction that can then be incorporated with other information or evidence that exists for the incident.

The Technical Directors who have worked on this project have 8 years' experience working as Police Staff specialists for the London Metropolitan Police Service conducting reconstructions of Crime Scenes and Major Incidents. They are experts in the field of 3D Geomatics and have produced evidence for hundreds of cases within the UK Criminal Justice System. They have been fortunate to have worked on some of the highest profile cases in recent decades and they continue to provide specialist support to Police and Security related organisations.

Since forming Advanced Laser Imaging, the team have been commissioned by Defence teams as well as Prosecution/Police and carry out other court work such as Civil courts (insurance) and Appeals.

ACRONYMS / DEFINITIONS

3D	3 Dimensions
ARLS	Automatic Resource Location System
Csv	Comma separated values - A text file
Digital Twin	An accurate Virtual 1 to 1 recreation of a real world scene
Digital Zoom	By enlarging pixels in the centre of the photo and cropping out the rest, digital zoom gives the appearance of magnifying the subject, while also lessening resolution and image quality.
EDM	Electronic Distance Measurement- is a method of determining the length between two points using electromagnetic waves.
Effective Focal length	Simplifying a complex cluster of lenses into a single virtual lens, the Effective Focal length is the relative distance from the sensor surface to the centre of this imaginary lens.
Frame Rate	The number of frames stored per second in a video or animation
Laser Scan	A survey technique involving a 3D scanner that measures millions of points in a scene during capture.
OSGB	Ordnance Survey Great Britain.
Photogrammetry	Techniques to take measurement from photography
Pointcloud	The common output from a laserscanner, a pointcloud is where a Digital twin is made up of millions or billions of individual points.
Registration	A process of stitching together multiple 3D laser scan generated pointclouds into a single large, pointcloud.
RTK	Real Time Kinematics - Used to improve the accuracy of GPS measurement to centimetres.
SOCO	Scene of Crime Officer
UAV	Unmanned Aerial Vehicle

1. TERMS OF REFERENCE

1.1. On 2nd August 2021, Advanced laser Imaging were contacted by The Sheku Bayoh Inquiry team regarding a possible reconstruction. They wrote

1.2. “The Inquiry, based in Scotland and constituted under the Inquiries Act 2005, is investigating the death of Sheku Bayoh while being restrained by Police Scotland in 2015. Further details regarding the Inquiry can be found on our website: https://www.shekubayohinquiry.scot/"

1.3. “The Inquiry is considering commissioning a digital reconstruction of events relating to the death of Mr Bayoh and is seeking a suitably skilled contractor to provide expert advice to the Inquiry, a quote, and then potentially take forward the reconstruction work.”

1.4. After a virtual meeting and supplying documentation including personal and business CVs, including a history of relevant work, Advanced Laser Imaging were commissioned by the Inquiry to go through the material and propose an outline for undertaking a digital reconstruction.

1.5. On 7th September Advanced Laser Imaging were commissioned to start handling the reconstruction on behalf of the Inquiry. After an initial paper review of available evidence, Advanced Laser Imaging produced an outline of steps required for the reconstruction on 14th November. This was submitted as Report ‘Sheku Bayoh Inquiry - Digital Reconstruction’. The process was agreed with the Inquiry team as a proper and sensible way forward. This document is shown in Appendix A.

2. OVERARCHING PRINCIPLES AND METHODOLOGY

2.1. As the project progressed, and in communication with the Inquiry team, it became apparent that we could class the majority of the material supplied in two categories, **Objective** material or **Subjective** material.

2.2. Objective information, for the purposes of the Digital Reconstruction, is defined as information that is not influenced by personal feelings or opinions in the representation of the facts.

2.3. Subjective information, for the purposes of the Digital Reconstruction, is defined as information that is based on or is influenced by a person's feelings, tastes, opinions or experiences.

2.4. The figure below shows typical examples of each material type.

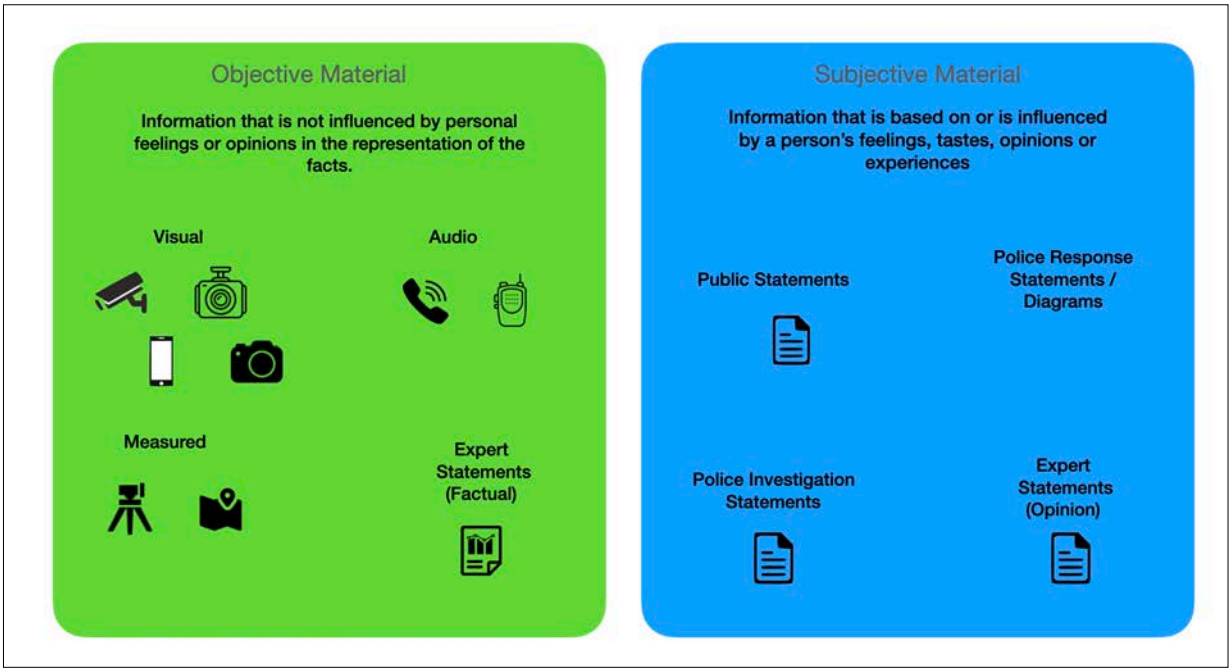


Figure 2.1 Examples of Objective and Subjective Material

2.5. Objective information is not necessarily accurate information and assessment has to be made on each piece of evidence to ascertain its suitability for use and whether the potential accuracy is suitable for the purpose it is being used for.

2.6. Subjective information can be more diverse in how it is expressed compared to Objective information and, therefore, interpretation is best conducted by a

number of persons to ensure a working consensus can be made and individual misinterpretation or bias can be minimised.

2.7. The figure below further breaks down the methodology and steps that were required during this project.

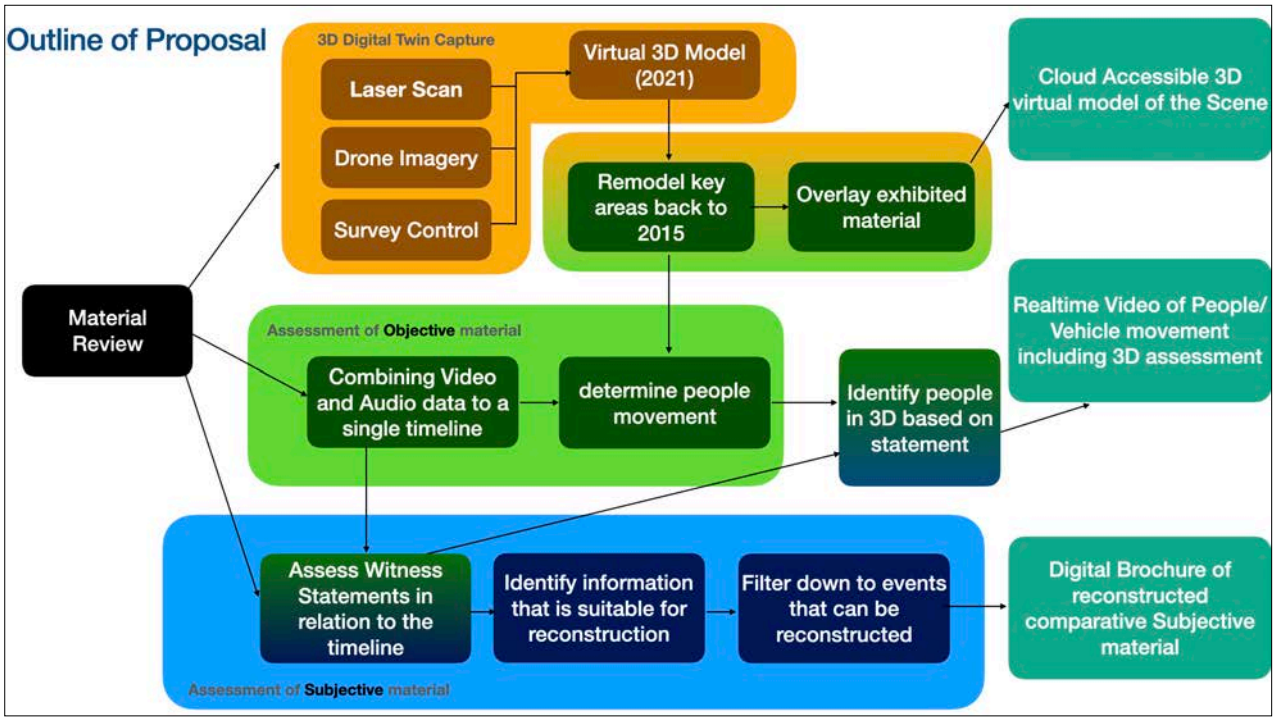


Figure 2.2 Detailed Methodology Statement

2.8. Three Main Products have been outlined to help support the Inquiry these are:

- 3D Model of the Scene - Accessible from a cloud system
- Realtime video of the Objective evidence
- Digital Brochure / 3D Model reconstructions of Subjective Material

2.9. As the project progressed there were regular meetings/briefings to discuss progress and not miss opportunities to exploit the works to potential as well as to ensure that the work to date met the expectations of the Inquiry.

3. MATERIAL RECEIVED

3.1.1. During the initial assessment of evidence there is also a requirement to categorise the information regarding its relevance to the purpose of the Digital Reconstruction.

3.1.2. Appendix B contains a list of the full material relied upon in the course of this work. Appendix C contains a list of all material received and reviewed by Advanced Laser Imaging.

3.2. Objective Material

3.2.1. VIDEO

3.2.1.1. DashCam Footage

3.2.1.1.1. Advanced Laser Imaging were provided with multiple versions and stills from Dashcam footage captured from Harry Kolberg's vehicle. It is unlikely that any of the versions supplied were the original files from the SD card, but versions created from it. The two versions provided with the video in isolation (i.e. not in a compilation) were:

- PIRC-01178 - PIRC010515.367 Harry Kolberg's Dashcam footage
- PIRC-01293 - PIRC010515.482 Infratech Compilation SD Card from Dashcam - Harry Kolberg Master Copy

3.2.1.1.2. PIRC-01178 has a resolution of 960 x 738 pixels. PIRC-01293 appears to be adapted from the original to play through a DVD player which is 720 x 576 pixels.

3.2.1.1.3.PIRC-01178 uses more modern H264 compression algorithms compared to Mpeg 2 used by PIRC-01293. The effect of this is nominal in appearance between the versions, and main benefits are around file size. The original footage, though not thought to be available, would have likely been captured in a H264 compression.

3.2.1.1.4. It should be noted that in all versions, there is a break of approximately 10 seconds in every 1 minute of footage. This may be down to the way the device stores the video, and if the SD card is slow, then the recording buffers may be exceeded causing a break in the stored footage. This is only a hypothesis as the system has not reviewed.

3.2.1.1.5. Because this footage doesn't capture the restraint and will be used in conjunction with other footage, it doesn't make a significant difference which version is used.

3.2.1.1.6. Harry Kolberg states his camera is out by an hour, however this appears to be approximate and no statements or analysis has been received that verifies the accuracy of the timecode.

(a) first sighting of S.Bayoh | *(b) second sighting of S.Bayoh*

Figure 3.1 Stills from dashcam - PIRC 01293

3.2.1.2. Gallagher's PH - Front

3.2.1.2.1. This footage was provided as a AVI (PIRC-01287), the video is low resolution 352 x290 Pixels and clearly using a wide angle lens. This is apparent by the barrel lens distortion towards the left edge of the video.

3.2.1.2.2. The video runs through the entire event, however the distance at which most events occur will make interpretation and analysis very difficult. On top of this it can be seen rain distorts the video at certain points, and that the ground surface becomes highly reflective, making it difficult to identify foot/ground contact positions.

3.2.1.2.3. From DC Fiona MCEWAN's statement on 15th March 2017 (PIRC-00176) referring to a CCTV assessment she carried out on 4th May 2015, the Gallagher's PH footage was running 10 mins and 52 seconds SLOW.

3.2.1.2.4. She does not however detail the timings that were captured from the CCTV or talking clock, so it is difficult to assess the validity of her findings.

(a) S.Bayoh Walking in road

(b) First Emergency Response Vehicle arrives

Figure 3.2 stills from Gallagher's PH CCTV

3.2.1.3. Mobile Footage

3.2.1.3.1. 'PIRC-01289 - PI010515.355 Robson Kolberg's iPhone footage' was taken by Robson Kolberg whilst in the passenger seat of Harry Kolberg's vehicle. The footage runs at the same time as the dashcam footage.

3.2.1.3.2. This shows some of the events before the arrival of the emergency services. The video is of high quality, but being hand held, there is motion blur and some sudden movement.

3.2.1.3.3. The video is of good quality, 1920 x 1090, however it is not possible to fully determine if the camera was capturing at optimal resolution or within a 'digital zoom' range of the device. As it is not possible to read the number plates of vehicles, it would suggest that the camera was using 'digital zoom' and therefore the actual resolution will be less than the image resolution, but it's not possible to determine how much effect this has.

3.2.1.3.4.There is no timecode to help place this footage, however as previously stated it overlaps with Harry Kolberg's Dashcam video which does have a timecode.

(a) Van turning in road

(b) S.Bayoh in road

Figure 3.3 Mobile Phone footage

3.2.1.4. Snapchat Footage

3.2.1.4.1. The following clips were extracted from Snapchat servers which were captured on Ashley Wyse's mobile phone

- PIRC-03368 - Snapchat-289718241049293671
- PIRC-03369 - Snapchat-2154007213033099882
- PIRC-03370 - Snapchat-2800019487722441065
- PIRC-03371 - Snapchat—4027412658762379031

3.2.1.4.2. These are the highest quality footage of the restraint available, however a hedge obscures critical detail in the footage. PIRC-03371 is a third the resolution of the other videos at 640 x 352 pixels, the reason for this is unknown. The remaining footage is 1920 x 1080.

3.2.1.4.3. It is clear that PIRC-03368 is zoomed in to the scene, and most likely using digital zoom. This suggests that the others are either not, or significantly less so.

3.2.1.4.4. These videos do not have timings, however, information provided in the form of a short report prepared by PIRC (PIRC-04514) gave some

thumbnail image creation dates and times that are useful. These are shown in the table below:

PIRC Reference	Video Name	Thumbnail name	Thumbnail creation
PIRC-03368	SNAPCHAT-289718241049293671	imgcache.0_2382_1430642562	03/05/2015 09:42:42
PIRC-03369	SNAPCHAT-2154007213033099882	imgcache.0_2357_1430634507	03/05/2015 07:28:27
PIRC-03370	SNAPCHAT-2800019487722441065	imgcache.0_2358_1430634462	03/05/2015 07:27:42
PIRC-03371	SNAPCHAT-4027412658762379031	imgcache.0_2359_1430634367	03/05/2015 07:26:07

Table 3.1 Thumbnail creation times

3.2.1.4.5. The thumbnails would have been created after the videos were saved, so therefore the videos must have been captured before these times.

(a) PIRC-03368 | *(b) PIRC-03369* | *(C) PIRC-03370* | *(d) PIRC-03371*

Figure 3.4 Snapshots from Ashley Wyse's Phone

3.2.1.5. Van Footage

3.2.1.5.1. A Van travelling through the area had cameras on board (PIRC-01285). Though this is unlikely to be the original captured footage, all versions of the footage provided are of really poor quality. The video is 320 x 258 pixels however the software compression appears to reduce the visual quality of video significantly more.

3.2.1.5.2. Though this video has a timecode, no statements or analysis has been received to determine whether this is accurate or not.

(a) vehicle just entering Hayfield Road

(b) vehicle turned around heading towards Hendry Rd

Figure 3.5 Snapshot from van.

3.2.2. AUDIO

3.2.2.1. 999/101 calls

3.2.2.1.1. 999 and 101 calls have been provided as mp3 files. Each file was accompanied with a csv file which stated the start time and duration of each call. For each call there was also a written transcript provided.

3.2.2.1.2. The table below summarises the calls that were shared.

Reference	Time	Duration	Name	Called
PS00001 D584 A388 14122020 C3 - 32630736 101 Call (C3)	2015-05-03 07:09:4	65	Simon Rowe	101
PS00002 D585 A388 14122020 C3 - 32630752 999 Call (C3)	2015-05-03 07:10:12	129	Harry Kolberg	999
PS00414 D586 A388 14122020 C3 - 32630762 999 Call (C3)	2015-05-03 07:10:59	102	Joyce Joyce	999
PS00004 D587 A388 14122020 C3 - 32630841 999 Call (C3)	2015-05-03 07:15:31	154	Alan Pearson	999
PS00005 D588 A388 14122020 C3 - 32630842 999 Call (C3)	2015-05-03 07:15:31	87	Harry Kolberg	999
PS00006 D589 A388 14122020 C3 - 32630860 999 Call (C3) copy	2015-05-03 07:16:34	80	Linda Limbert	999
PS00007 D590 A388 14122020 C3 - 32632830 999 Call (C3) copy	2015-05-03 08:36:02	345	Collette Bell	999

Table 3.2 Phone call made to 999 /101

3.2.2.2. Airwave

3.2.2.2.1. Airwave refers to the emergency services radio network which is used as the main form of communication within operational Police units.

3.2.2.2.2. Groups of users are placed on the same channel, with each unit having its own URN. Airwave units can be handheld or vehicle mounted devices.

3.2.2.2.3. They also produce additional data from sensors such as GPS, this is referred to later in the report as ARLS.

3.2.2.2.4. Each unit has an Emergency Button which can be pressed if an officer is in trouble. This opens and gives priority to the microphone of the unit for 10 seconds, which can be cancelled by the controller though this is not recommended.

3.2.2.2.5. Airwave calls were provided as both a track and as a set of mp3 files. These are from the 'Kirkcaldy 1' Talkgroup.

3.2.2.2.6. Additionally further files were provided including calls to Ambulance Services and other talk groups.

3.2.2.2.7. All Airwave communications are stored with accurate times to the second.

3.2.2.2.8. Additionally we were supplied with PIRC-01399 which is a transcript of the airwave produced by PIRC.

3.2.3. PHOTOGRAPHY

3.2.3.1. Police gathered photography and videography of the area. In DC Brian O'Neill's Statement, he mentions that these were captured by Scene of Crime Officers (SOCOs) Pamela PATERSON and Malcolm FOY. This appears to be after 18:12 on the day of the incident.

(a) bus stop

(b) path to Hendry Road

(c) area of restraint

Figure 3.6 Crime Scene Photography - PS00181

3.2.3.2. In addition to this the Police recovered a knife from the scene. This was carried out whilst the incident was in progress by PC Derek CONNELL. The images were captured on his mobile phone before being exhibited. Although three images were taken, only one has been provided in sufficient resolution. This image was supplied in its original format with its Exif data intact. The figure below shows the image and the exif data.

(a) Photograph of knife

ModifyDate	2015:05:03 07:27:57
GPSDateStamp	2015:05:03
GPSAltitudeRef	Above Sea Level
GPSLongitudeRef	West
GPSImgDirection	209
GPSLongitude	3.170819
GPSProcessingMethod	ASCII
GPSLatitudeRef	North
GPSImgDirectionRef	Magnetic North
GPSTimeStamp	06:27:19
GPSAltitude	150 m
GPSLatitude	56.125465
Model	Nexus 5
YCbCrPositioning	Centered
ResolutionUnit	inches
YResolution	72
ColorSpace	sRGB
CreateDate	2015:05:03 07:27:57
FNumber	2.4
FocalLength	4.0 mm
ApertureValue	2.4
WhiteBalance	Auto
ExifImageWidth	2448

(b) Exif data

Figure 3.7 Knife Image with Exif Data

3.2.4. MEASURED SURVEY

3.2.4.1. On the evening of 3rd March 2015 at 19:55hrs a 3D Survey was conducted by PCs Paul MCANDREW and Adam WEIR from the Road Traffic Collision Unit as noted by DC Brian O'Neill in his statement.

3.2.4.2. It is believed the capture was conducted using a Leica P20 Laser Scanner by the filetypes of the raw data. The P20 is a terrestrial tripod mounted device. In total three positions were captured at the scene in colour.

3.2.4.3. Post the scene capture, these were produced into Leica's 'truview' product, which is a basic viewer allowing users to navigate between scan positions and view them as panoramic images.

3.2.4.4. We also obtained the raw sensor data for processing. We have not been given access to or seen a service certification for the unit, however, as we were independently capturing the same scene any obvious issues with the scanner would be picked up in the course of the reconstruction.

3.2.4.5. The raw sensor data from the 3D survey was registered to link the three scan positions together. This process is detailed in the report supplied in Appendix D.

3.2.4.6. The Figure below shows some 3D images of the data captured.

(a) Parked Cars Positions	*(b) Bus Stop Area*	*(c) General View*

Figure 3.6 Images from the 2015 laserscan data

3.2.5. GPS - ARLS

3.2.5.1. As previously stated, the radio systems used for Airwave also captures and share other sensor data. ARLS (Automatic Resource Location System) stores GPS positions taken by the radio units.

3.2.5.2. A simple guide to understand accuracy for GPS can be found at https://www.gps.gov/systems/gps/performance/accuracy

3.2.5.3. Here it states typical accuracy to be within 4.9m under ‘open sky’ conditions. This is outdoor areas with good visibility to the sky. It also describes errors that can occur due to reflected signals, this can happen in built up areas, or internal areas.

3.2.5.4. Further to this if the number of satellite signals seen up by the unit drops, then the GPS position may not be captured at all.

3.2.5.5. The table below shows who held the available units and the time range for which data was extracted.

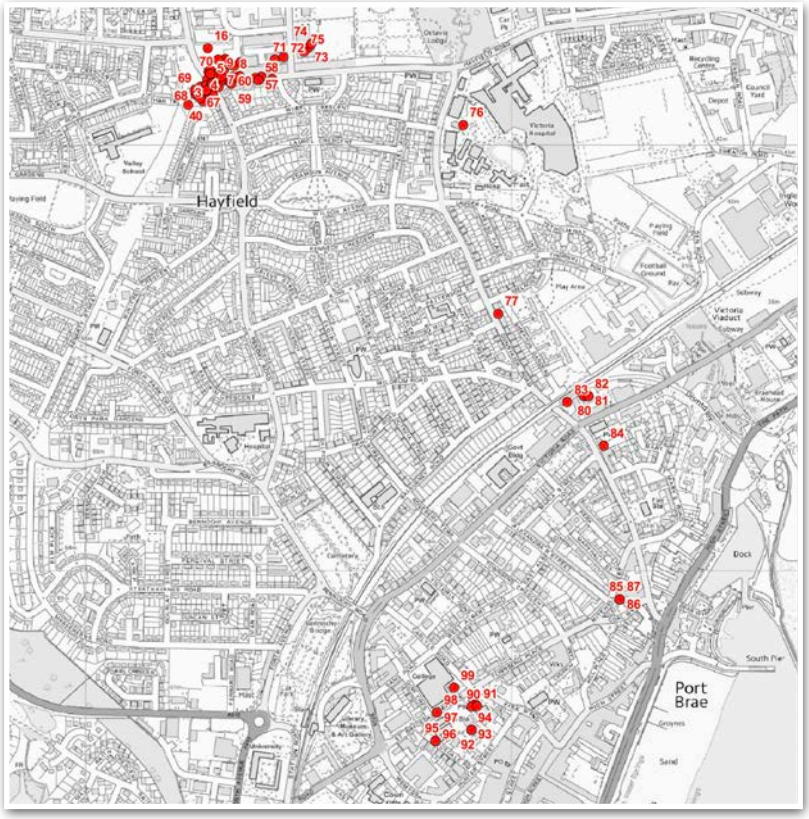
ID	Name	start	End	
Vehicles				
6552158	Ford Connect	06:18:36	08:58:18	
6552017	Ford Transit - Crew	06:19:31	08:58:49	
People				
6550203	PC Kayleigh GOOD	06:26:19	07:51:50	
6550285	A/PI Steven KAY	06:43:19	07:28:32	
6550349	A/PS Scott MAXWELL	06:05:19	06:50:33	
6550374	Andrew Brown	06:53:13	14:50:55	No data for the time period specified, but data later in the day requested.
6550405	DC Derek CONNELL	06:25:53	07:29:05	
6550435	PC James McDONOUGH	06:20:39	07:51:25	
6550465	Ryan Balsillie	18:51:11	22:37:46	No data for the time period specified, but data later in the day requested.
6550523	PC Craig WALKER	06:29:56	07:20:42	
6550691	PC Ashley TOMLINSON	06:28:51	06:49:18	
6550694	PC Alan PATON	06:37:14	07:27:54	
6550724	PC Daniel GIBSON	06:21:05	07:20:56	
6550918	DS Samantha DAVIDSON	06:27:04	07:07:39	
6550919	DI Colin ROBSON	06:27:29	07:01:23	
6551014	PC Nicole SHORT	06:23:22	09:23:58	
6551035	PC Alan SMITH	06:23:21	07:25:32	

Table 3.3 ARLS units and times

3.2.5.6. The ARLS data was provided both as Raw data (a csv file) and as points plotted on a map.

Node	Class	Date Time	Contents	Event ID	Event	In fix	Latitude	Longitude	Speed	Bearing	Status	EWires	MWires	Location	Geofence	Data
6550203	HANDPORTABLE	03/05/2015 06:26:19	106	65	Fix	In Fix	5607.5334N	00310.2380W	0	40	0	0	0	At Hendry Road-Kirkcaldy	0	0006550203
6550203	HANDPORTABLE	03/05/2015 06:27:53	106	48	Unknown 30	In Fix	5607.5462N	00310.2387W	0	42	0	0	0	At Hendry Road-Kirkcaldy	0	0006550203
6550203	HANDPORTABLE	03/05/2015 06:28:34	74	42	E11	In Fix	5607.5018N	00310.3182W	0	42	0	0	0	At Lothian Terrace-Kirkcaldy	0	0006550203
6550203	HANDPORTABLE	03/05/2015 06:29:04	106	65	Fix	In Fix	5607.5240N	00310.2833W	0	113	0	0	0	At Lothian Terrace-Kirkcaldy	0	0006550203
6550203	HANDPORTABLE	03/05/2015 06:30:35	74	42	E11	In Fix	5607.5329N	00310.2562W	0	113	0	0	0	At Lothian Terrace-Kirkcaldy	0	0006550203
6550203	HANDPORTABLE	03/05/2015 06:31:05	74	65	Fix	In Fix	5607.5535N	00310.2247W	0	113	0	0	0	At Hendry Road-Kirkcaldy	0	0006550203

(a) csv data



(b) Plotted data

Figure 3.7 ARLS data provided as raw and visual aid.

3.2.6. EXPERT / TECHNICAL REPORTS - FACTUAL

3.2.6.1. In addition to the above material we were also given material from experts in the field of Airwave, ARLS, and other background material to assist with technical understanding of different systems and/ or the analysis that was carried out, these include:

- PIRC-03838 - Airwave Overview - PIRC - Feb 2018
- PIRC-00507 - S376 Colin GILL Statement
- PIRC-04514 - Operation Quoich Report on Snapchat and WhatsApp timestamps variances
- PIRC-00176 DC Fiona MCEWAN - Timing of Gallagher's Pub Footage
- PIRC-00327 John WILSON - Collection of ARLS data

3.3. SUBJECTIVE Material

3.3.1. During the initial assessment of evidence there was also a requirement to categorise the information regarding its relevance to the purpose of the

Digital Reconstruction. The Statements listed below are those relevant to the reconstruction period.

3.3.2. PUBLIC STATEMENTS

3.3.2.1. The following Public Statements were assessed.

- PIRC-00019 Kevin Nelson
- PIRC-00043/44 Ashley Wyse
- PIRC-00056/57 Hazel Sinclair
- PIRC-00075 Abdeloouhab GUESSOUM
- PIRC-00084 Akhtar ALI
- PIRC-00117 Danny [redacted] ROBINSON
- PIRC-00120 Sean MULLEN
- PIRC-00251 Christopher FENTON
- PIRC-00308 Callum CRUICKSHANK
- PIRC-00312 Pauline CRUICKSHANK

3.3.3. POLICE RESPONSE STATEMENTS

3.3.3.1. The following Police Statements were assessed.

- PS00379/PIRC-00185 DS Samantha DAVIDSON
- PS00280/PIRC-00223 DI Colin ROBSON
- PIRC-00253/4 PC Nicole Short
- PIRC-00258 PC Daniel [redacted] GIBSON
- PIRC-00262 PC Alan PATON
- PIRC-00263 PC Ashley TOMLINSON
- PIRC-00264/5 PC Craig WALKER
- PIRC-00266/7 Scott MAXWELL
- PIRC-00273 James MCDONOUGH

- PIRC-00274 PC Kayleigh GOOD
- PIRC-00278 PC Alan [redacted] SMITH
- PS00757/PIRC-00047 DC Derek CONNELL

3.3.4. POLICE INVESTIGATION STATEMENTS

3.3.4.1. The following Police Statements were assessed

- PIRC-00129 DC Brian ONEILL

4. DIGITAL TWIN CREATION

4.1. Before attending site, the area for reconstruction was determined. In conversation with the Inquiry, the main area of interest was where Sheku Bayoh was captured on Video.

4.2. To further assist the Inquiry it would be helpful to understand the location of key landmarks that are seen in the videos.

4.3. The figure below shows the area that was determined for the survey.

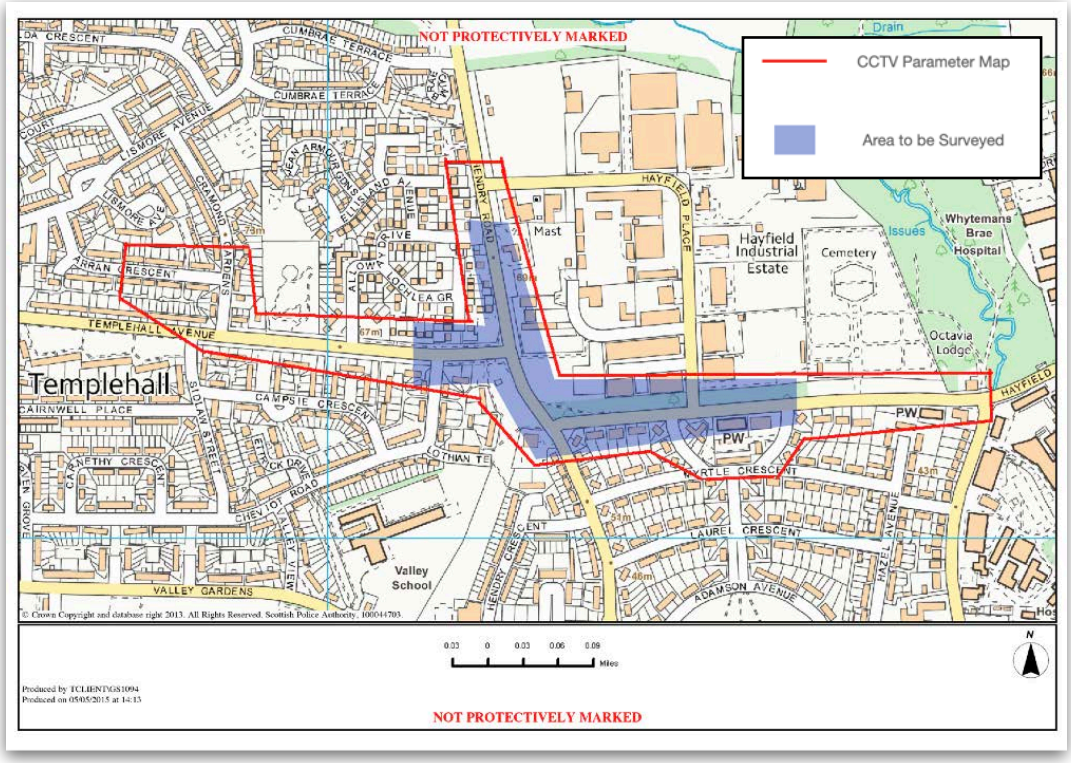


Figure 4.1 Area to be surveyed

4.4. Site Survey

4.4.1. On 15th and 16th December 2021 ALI and subcontracted parties attended the site to capture the scene for the 3D reconstruction. Calibration Certificates for the survey equipment used can be found in Appendix E. There were three components to the survey.

4.4.2. LASER SCAN CAPTURE

4.4.2.1. A Faro S150 Laser scanner was used to capture the scene in 3D. This is a tripod mounted device that uses a near infrared laser to measure

distance. Its general accuracy is 3.5mm at 25m from the device. It has a range of 150m from the device.

4.4.2.2. Over 80 positions were captured across the scene. Each scan capturing approximately 12-15 millions points.

Figure 4.2 Laser Scanner capturing Hayfield Road

4.4.3. DRONE CAPTURE

4.4.3.1. Due to Hayfield Road being a main route from the hospital and the Civil Aviation Authority requirements to fly drones, the weight of the drone that could be used on this project was limited to below 250g.

4.4.3.2. The site was therefore captured using DJI Mini 2 UAV. This has a 12 MegaPixel Camera and would require no permissions or road closures to fly in a public space.

4.4.3.3. Over 2500 images were captured of the site which include Nadir (straight down) and oblique (45 and 60 degree) Photography.

(a) Nadir Imagery - Hayfield Road

(b) Nadir Imagery - Hendry Road

(c) Oblique Imagery - Hendry Road/Hayfield Road

(d) Oblique Imagery - Hendry Road

Figure 4.3 Imagery Captured

4.4.4. SURVEY CONTROL

4.4.4.1. Adding survey control offers three benefits to creating the model

- It provides an accurate frame of points to bind the laserscan to.
- This frame of points can also be used to verify the accuracy of the model
- It allows the model to be positioned on OSGB mapping coordinates, which means that point references can be located on mapping from the model.

4.4.4.2. The survey was conducted using GPS and EDM survey equipment. The GPS uses RTK network positioning which increases the accuracy of measurement to between 30-50mm. This is used to locate the base station's positions from which the points are captured.

4.4.4.3. In this work we used 'natural' targets such as corners of buildings, linework, Inspection covers and street furniture to control the model. 518 points were captured across the site, this added redundancy as fewer points are required to position the model.

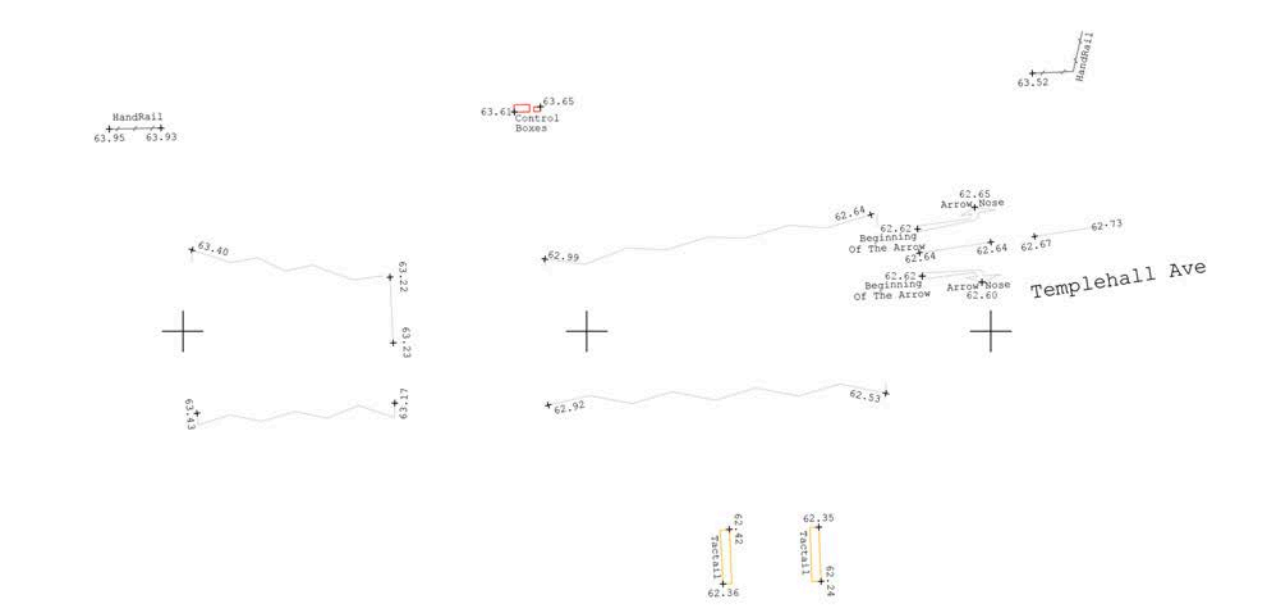


Figure 4.4 Some of the control points captured on Templehall Avenue

4.5. Registration and Clean

4.5.1. Post the data capture of the scene, the laserscan data is stitched together by using common features from one scan position to another, this initial registration produced a Mean Point error of 3.4 mm and a Maximum error of 18.5 mm. It should be noted that the two scans with 18.5mm errors were outliers with next highest being 8.5mm.

4.5.2. As the roads were busy throughout the day, there were a lot of vehicles and people captured within the scene.These had to be cleared from the data at this point too. This work was conducted in FaroScene version 2022.

4.6. Combining Assets

4.6.1. Using Software Reality Capture Version 1.2 the following assets were combined

- 83 Laser Scan positions
- 1954 UAV Images

4.6.2. There are technical and practical reasons for not including the entirety of the image and control dataset in the processing. The point of over capturing a scene is to add enough redundancy to avoid future site visits. There are practical limitations based on the computer hardware being used to process

the data and even though sections can be broken down to negate some of these it would lead to further issues in terms of alignments of the model sections created.

4.6.3. Lastly there is a limit to what can be achieved due to pixel resolutions and adding further images would not increase the quality of the final model but would affect the time to process and deliver the model.

4.6.4. Post the models creation, it was further cleaned within Software Reality Capture.

4.6.5. The Figure below shows the model that was created.

(a) Full model

(b) Hayfield Road

(c) Templehall Avenue

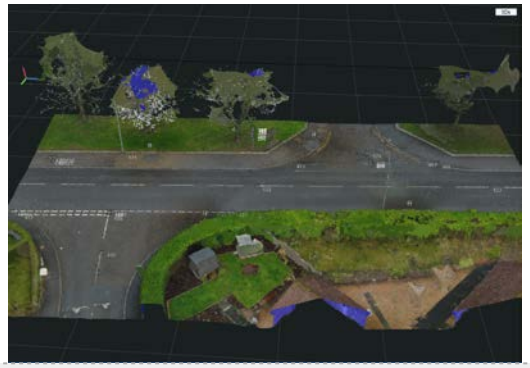
(d) Hendry Road

Figure 4.6 3D model generated

4.7. Assessing model Accuracy

4.7.1. The figure below shows several areas of model in comparison to the control points captured, it shows an excellent correlation between the model and control.

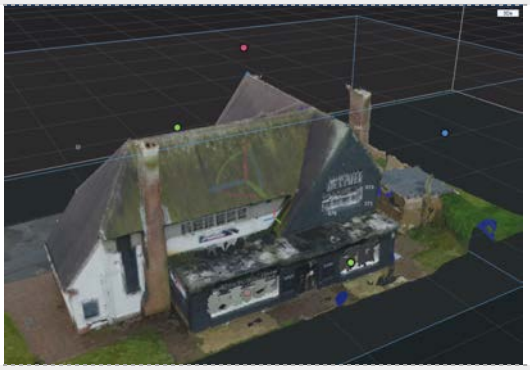
(a) Hayfield Road near junction



(b) Hayfield Road near Poplar Crescent

(c) Bus stop on Hendry Road

(d) Petrol Station on Hendry Road



(e) Gallagher's Public House

(f) Templehall Avenue

Figure 4.7 Overlay of control onto the 3d model showing good alignment

4.8. Variations from 2015 Dataset

4.8.1. The model created is true to the time it was surveyed which is December 2021, however the events of concern occurred in May 2015. By comparing

the model to the crime scene Photography and the 2015 laser scan dataset several areas were identified which had changed over the time. These are highlighted in the figure below and listed in Appendix F.

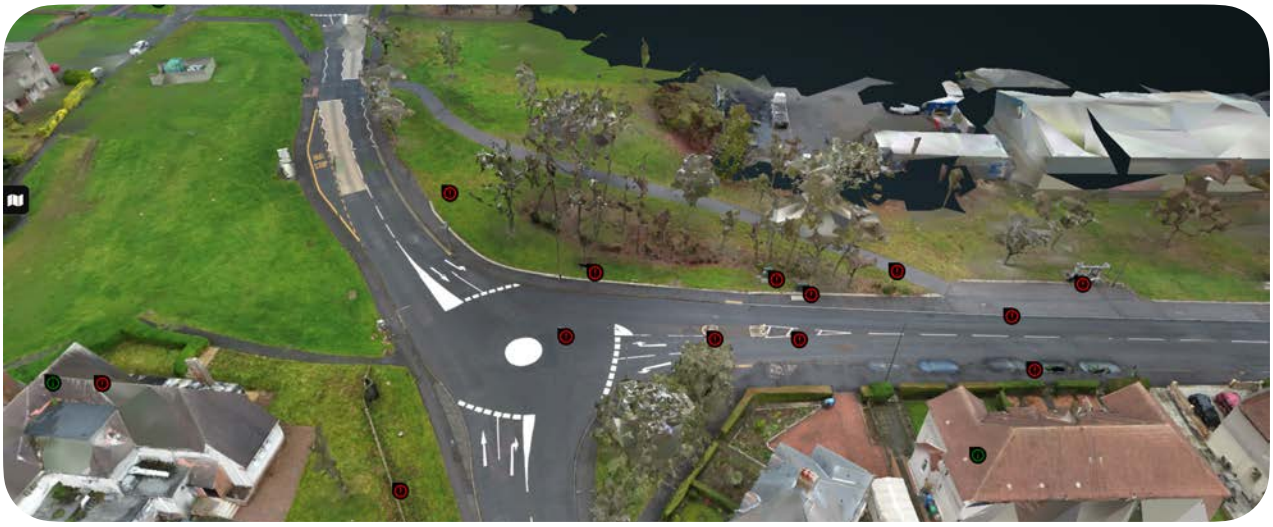
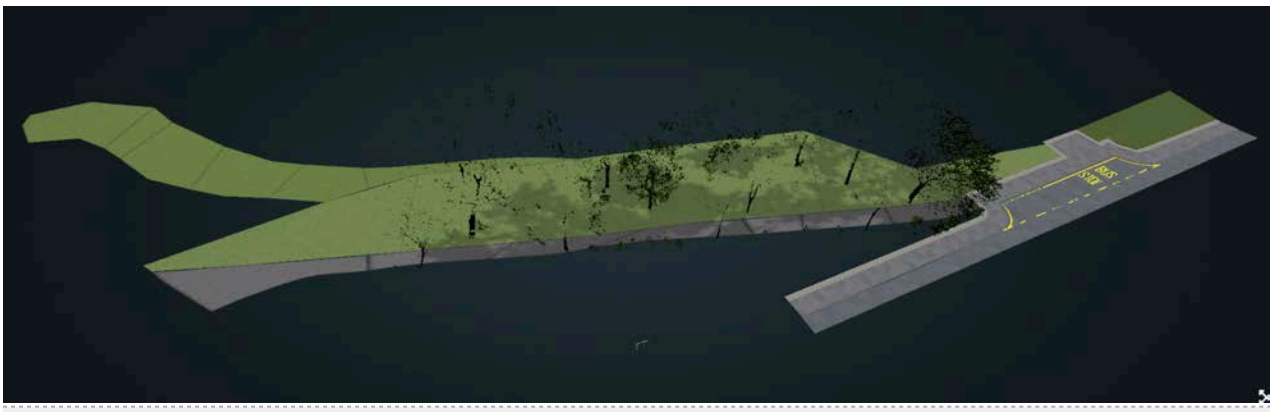


Figure 4.8 Area of changes between 2015 and 2021

4.8.2. It should be noted that these variations are only around Hayfield Road and the junction of Hendry Road, where the source material was available.

4.8.3. A list detailing these variations was submitted to the Inquiry for any alterations that they felt were necessary to be remodelled. The Inquiry requested that A1, A3, A4 and A5 (Appendix F) be adjusted to represent the scene from 2015.

4.8.4. Further to this they requested that the Road sign to Hayfield Road be modelled so it would be clearer. The areas were remodelled in 3D Studio Max 2022, taking the topology from the 2015 laserscan data to recreate the road surface and path. The figure below shows the remodelled areas.



(a) Remodelled area

(b) Scene with remodelled section

(c) Bus Stop Area

(d) Path exit onto Hendry Road

Figure 4.9 Renders of the remodelled section combined with the 2021 model

4.8.5. The resulting model is a **hybrid** between the 2021 and 2015 datasets.

5. ASSESSMENT OF OBJECTIVE EVIDENCE

5.1. Measured Survey Data

5.1.1. The Leica survey was conducted on the evening of the incident. It was done after the exhibit markers had been placed in the scene. The road had been cordoned and closed during the events in the morning so the vehicles scanned within the cordon were in the same location in the scan data as they were at the time of the events.

5.1.2. PARKED VEHICLE LOCATION AND MAKE/MODEL IDENTIFICATION

5.1.2.1. Vehicles in the scene were identified by the number plates in several cases. Exception to this was the Mini Cooper which has a very unique identifiable shape.

5.1.2.2. Using the site www.mycarcheck.com to carry out a basic DVLA check, the following vehicles were identified along Hayfield road, within the cordon.

- Saab, 9-3 ARC, 2004
- Ford, Mondeo, 2004
- Vauxhall Corsa 3 door, 2004
- Mini Cooper S, 2015
- Nissan Qashqui, 2008

5.1.2.3. 3D Models were purchased which were either the exact vehicle model, or if that model wasn't available, the same vehicle model but a slightly different version.

5.1.2.4. The 3D models were optimised, textured and then added to the scene. The final result is shown in the images below.

(a) Vehicles in cordon - Front

(b) Vehicles in cordon - Back

(c) vehicles placed into the scene in the model

Figure 5.1 Models of parked Vehicles in scene

5.1.3. PRODUCTION LOCATIONS

5.1.3.1. In Brian O'Neill's Statement, he mentions 6 production markers placed at the scene which were photographed. These were:

- 1 Hand Gel
- 2 Vaseline
- 3 CS Spray Cap
- 4 Red Plastic Cap
- 5 Chewing Gum
- 6 Pen

5.1.3.2. They were also still in the scene when the 3D Survey was conducted. Though the scans were not refined enough to read the numbers, the locations were picked up, which relate well to the scene photography.

5.1.3.3. The figure below shows the location of the productions positioned back into the 3D Model.

(a) Location of productions in 2015 data

(b) Location of productions overlaid onto model

Figure 5.2 location of productions onto Model

5.2. Location of Knife

5.2.1. The knife was removed from the scene by DC D Connell whilst Sheku Bayoh was being restrained. DC Connell states

'Due to the mention that a knife was involved, I began to have a look on the street for any signs of it, when a uniformed officer shouted to me that it may be on the grassy area on the North side of the road.' - PS00757

5.2.2. He then proceeds to notify senior officers on the scene before photographing the knife with his personal mobile and seizing it. This suggests he was not the officer to first notice the knife, but was responsible for removing it from the scene.

5.2.3. This also means the knife was not in place when the laser scanning or photography was conducted later that day. Although three images were taken of the knife, only one appears to have been exhibited. This is shown in the figure below along with image's 'exif ' data.

ModifyDate	2015:05:03 07:27:57
GPSDateStamp	2015:05:03
GPSAltitudeRef	Above Sea Level
GPSLongitudeRef	West
GPSImgDirection	209
GPSLongitude	3.170819
GPSProcessingMethod	ASCII
GPSLatitudeRef	North
GPSImgDirectionRef	Magnetic North
GPSTimeStamp	06:27:19
GPSAltitude	150 m
GPSLatitude	56.125465
Model	Nexus 5
YCbCrPositioning	Centered
ResolutionUnit	inches
YResolution	72
ColorSpace	sRGB
CreateDate	2015:05:03 07:27:57
FNumber	2.4
FocalLength	4.0 mm
ApertureValue	2.4
WhiteBalance	Auto
ExifImageWidth	2448

(a)Photograph of knife - PS13559 *(b) Knife Exif data*

Figure 5.3 image and metadata of knife

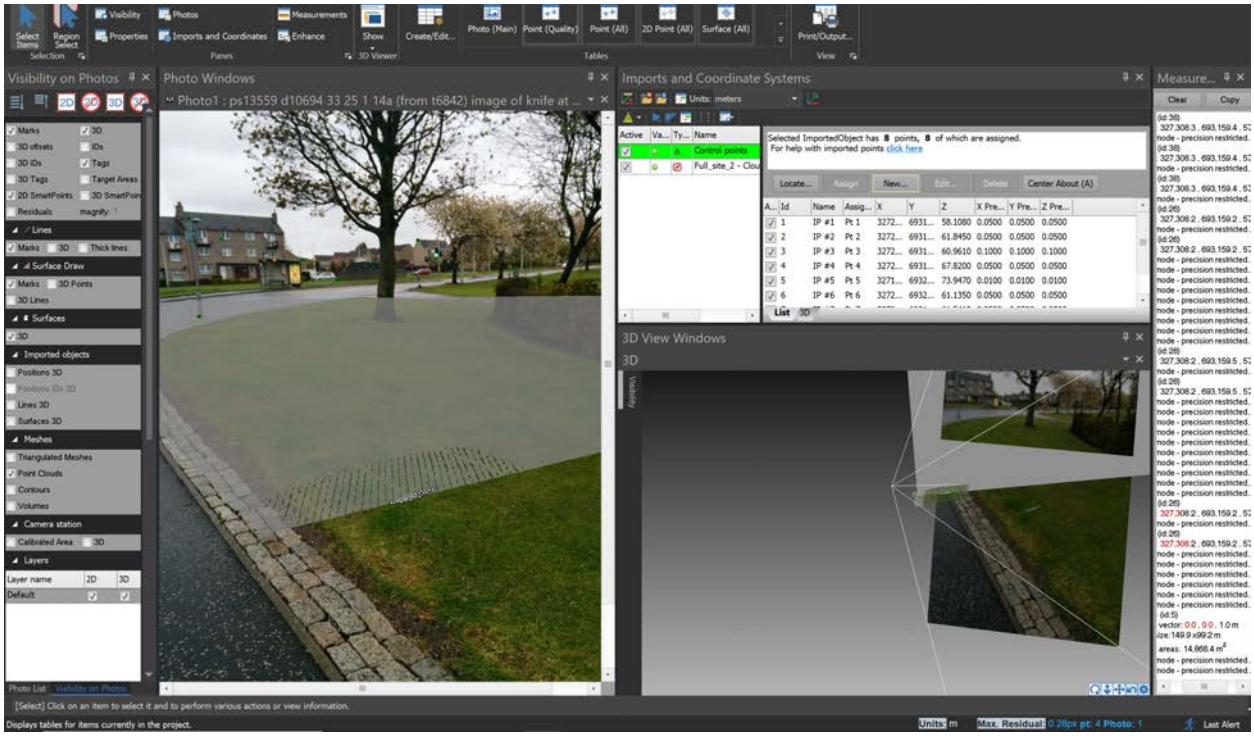
5.2.4. The time of the photograph is shown as 07:27:57. The process of positioning the knife from photography is known as laserscan assisted photogrammetry.

5.2.5. This is where common points are taken between a pointcloud dataset and an image to 'calibrate' and position an image back into the 3D Scene. For highly distorted images around 15- 20 points are required, however where less distortion is present images can be calibrated with fewer points. Lens distortion occurs when wide angle lenses are used, and can be seen where straight

objects such as walls or lampposts appear to be curved in the image. This becomes more prevalent towards the edges of the image.

5.2.6. In this case there is no noticeable lens distortion, so therefore fewer points can be used to calibrate and position the photograph. 9 points were used in this case, which produced an accuracy of 0.03 m RMS. The maximum error being 0.0526 m. For the purposes of repositioning the knife, this accuracy is more than adequate.

5.2.7. To position the knife a section of the pointcloud was converted to a 3D mesh which was then imported into the software, This model was then used to draw the outline of the knife on. The figures below show the screenshot and output of the analysis.



(a) Screenshot from Photogrammetry package

Calibration type	Field Calibration
Focal length (mm)	3.38
Image size (pixels)	2448 x 3264
Format size (mm)	2.95 x 3.97
Principal point (mm)	1.6 x 2.03
Lens distortion (K)	K1[-0.00717] K2[0.00132] K3[0]
Lens distortion (P)	P1[0] P2[0]
Quality - Residuals	RMS[0.134] Max[0.276]
Quality - Coverage	32.2
Multispectral	No

(b) Camera parameters

(c) Location of knife in 3D Model

Figure 5.4 Photogrammetric analysis

5.3. Evidence Video Timeline (SBPI-00046)

5.3.1. The Video and Audio supplied are difficult to understand as much of it isn't put in context and certainly it is almost impossible to cross reference video and audio information in relation to the events as they occurred. In order to overcome this, it was decided to create a video containing as much of the video and audio elements as possible, all placed against a real time clock.

5.3.2. These various productions were firstly broken into three categories,

- Productions whose events are known to the real time clock
- Productions whose events are unknown to the real time clock

- Productions whose events have partial constraints to the real time clock.

5.3.3. These various productions are shown in the figure below.

Figure 5.5 Audio /Video assets to be included.

5.3.4. HARRY KOLBERG'S DASHCAM FOOTAGE

5.3.4.1. The dashcam footage has a timecode, which Harry Kolberg said is an hour out. If the clock does not update between GMT and BST then it is highly unlikely that the device's clock is synchronised to a real time server. The clock could therefore be slow or fast an unknown amount of time.

5.3.4.2. However, there are two 999 calls made by Robson and Harry Kolberg which were captured/partially captured on the dashcam footage.

5.3.4.3. By reading the csv files attached to 999 call PS00002 (see table 3.2) it states a start time of 07:10:59, this is assumed to be BST. Using Abode Premiere Pro the call is aligned to the audio heard in the dashcam. This gives a start time for the call as 08:11:29 on the dashcam footage. This makes the dashcam footage 1 hour, 1 minute and 17 seconds faster than the 999 call time.

5.3.4.4. Using the same process as above, PS00005 begins at 07:15:31. As the start of the call occurs in one of the 'gaps' in the dashcam, we will use the end of the video for alignment. This clip has a duration of 87 seconds, making the end time 07:16:58. The dashcam time at this point is 8:18:14. This makes the dashcam footage 1 hour, 1 minutes and 16 seconds faster than the 999 call time. Both call times agree well with each other.

5.3.5. VALIDATION OF GALLAGHER PUBLIC HOUSE TIMINGS

5.3.5.1. The Gallagher Public House video system was assessed by officers using the talking clock method to record the time difference. The process though being generally reliable can be misaligned due to human error. As this footage is critical to understanding the scene, it was important to validate the findings of the officers.

5.3.5.2. Taking a common point between the Dashcam footage and the Gallagher Footage, one can assess the now corrected timings on the dashcam to determine the time difference of the Gallagher's Footage. The figure below shows the time when Harry Kolberg's vehicle stops on both systems.

(a) DashCam at 08:14:34 | *(b) Gallagher PH at 07:02:24*

Figure 5.6 Common shot from dashcam and Gallagher's PH video.

5.3.5.3. The time on the Gallagher's PH footage is 07:02:24 when the Dashcam reads 08:14:34. Based on the Dashcam footage time difference calculated above, the Real Time for this event is 07:13:17. This makes the calculated time difference of Gallagher PH of **10 minutes 53 seconds.**

5.3.5.4. The 1 second time difference can easily be accounted for in the timing of the 999 calls. For this reason we will take the officer time of 10 minutes and 52 seconds as being the accurate figure.

5.3.6. SNAPCHAT FOOTAGE ALIGNMENT

5.3.6.1. The snapchat footage was captured on Ashley Wyse's mobile phone. The nature of snapchat is that the video is no longer available after a set

period of time. This meant that the metadata which would contain the file creation/modification date were not available.

5.3.6.2. However a detailed assessment of the phone was carried out and the investigator found several thumbnail images which relate to the video files of interest.

5.3.6.3. Thumbnail images are small image files that are created after a file has been generated so that computer systems and devices can list the content of a folder much faster than reading each and every file.

5.3.6.4. As previously stated this means that the creation time of the thumbnail constrains the latest time at which video could have been captured. In the cases of PIRC-03369 and PIRC-03370, we can link officer positions, and public vehicles in the scene to the Gallaghers footage. It shows the thumbnails are created seconds after the video ends.

(a) PIRC-03370

(b) PIRC-03369

(c) PIRC-03370 equivalent time on Gallagher Footage (07:27:31 real time)

(d) PIRC-03369 equivalent time on Gallagher Footage (07:28:18 real time)

Figure 5.7 Common features in PIRC-03369 and PIRC-03370

5.3.6.5. However for PIRC-03371, the timing of thumbnail does not follow the same pattern as there are clear differences between the Gallaghers

footage and snapchat footage around the time of the thumbnail cache creation.

(a) Snapchat Footage

(b) Gallagher Pub footage

Figure 5.8 Variation between views

5.3.6.6. The Gallagher Footage shows a small grey hatchback passing the scene at that point and two police vehicles at the entrance to Hendry Road, which suggests that not only is the time period incorrect, but the event in the snapchat occurs significantly earlier.

5.3.6.7. By looking at the Gallagher public house footage, the first vehicle parked at the junction occurs at 07:21:41, but there is static traffic behind that vehicle until 07:22:03 which represents the start point at which the footage could occur. At 07:22:27 the second police vehicle arrives which is the last point in which the video could have been captured. Also at 7:22:18 a red vehicle passes through Hendry Road, limiting the time down further.

Gallagher footage at 07:22:03 - arrival of first vehicle

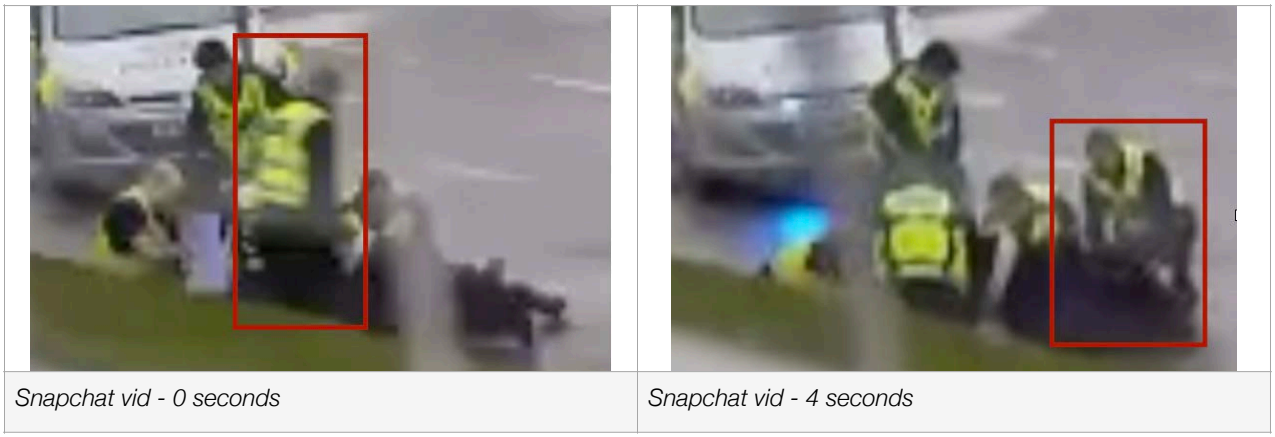
Gallagher footage at 07:22:27 - arrival of second police vehicle

Figure 5.9 Constraints of snapchat footage

5.3.6.8. The camera from the snapchat footage looks towards Hendry Road for 6 seconds without any vehicles coming into view, therefore the times at which the footage could occur are limited to between 7:22:03 - 7:22:12 as either the red vehicle or the second police vehicle would appear in the footage after this time.

5.3.6.9. Within this time period at **7:22:10** in the Gallagher footage there appears to be a person move from right to left and crouch down. This matches one of the officers seen from the snapchat footage. This therefore is the only time at which the snapchat footage could have been captured.

07:22:10 | *07:22:15*



Snapchat vid - 0 seconds | *Snapchat vid - 4 seconds*

Figure 5.10 movement of officer

5.3.7. OTHER CAMERA TIMINGS

5.3.7.1. The remaining video footage that can be aligned is Robson Kolberg's mobile video and the video known as 'van driven by witness Grey'. Both of these videos overlap with Harry Kolberg's Dashcam footage, which makes them easier to place.

5.3.7.2. Robson Kolberg's video can positioned by both video and audio, which matches to the dashcam footage, see the figure below.

(a) Dashcam footage, brake lights on van on

(b) Mobile footage, brake lights on van on

Figure 5.11 comparing Dashcam and Mobile Footage

5.3.7.3. The white van seen in figure 5.11 is a vehicle containing the cameras for the Van driven by witness Grey. Therefore it possible to match the movement of the van with video as it turns around at Poplar Crescent.

(a) Van turning in mobile footage

(b) Van turning in 'Van driven by witness Grey' footage

Figure 5.12 Comparison of van footage to mobile footage

5.3.8. 999/101 CALLS

5.3.8.1. The 999 /101 calls are timed and accurate to within 1 second. The difference occurs because it appears that the time is truncated to seconds. For the purposes of the reconstruction this should be adequate.

5.3.8.2. One anomaly to resolve was that the timing of a 999 call by Joyce Joyce has two start times attributed to it, the csv file attached to PS00003 (also known as PS00414) gives a start time of: 07:10:59 however the STORM report attached in the same exhibit gives the time of the call as 07:15:42.

The response from Police Scotland is that the STORM reports are written after the call and therefore would not accurately reflect the time of call.

5.3.8.3. When placing these into the video edit there was significant overlap during the calls. It was decided that all of the audio would be included however only the starting part of the call would be played at full volume before being dropped down to background noise, this way people watching the event will understand when each call starts, but not necessarily the full content of the calls. It was felt that individual calls can be played separately if needed.

5.3.9. AIRWAVE

5.3.9.1. The timings here are similar to 999 / 101 calls where start times are given to the second, so sub second placement is not possible. This should be considered when watching the video as certain phrases can be heard momentarily before it is seen due to this.

5.3.9.2. The airwave was taken from the 'Kirkcaldy 1' channel where the majority of the communication was captured. We were given access to other channels, however most of this was not relevant. The two that were useful are where the controller calls the ambulance service for an update. These two have been added together as the overlap wasn't overly distracting.

5.4. ARLS

5.4.1. The GPS Data currently provided as csv table, this contained Lat/Lon and time information. Through trial and error, the Latitude / Longitude data was found to be in the format hours/minutes/seconds however the seconds component was in base 100 as opposed to base 60.

5.4.2. This was verified by comparing the location on the plots provided. To show this on OSGB mapping, the coordinates need to be converted from WGS84 to OSGB36. This was carried out using the Ordnance Survey batch convertor. This process can add an extra 2 metres of error onto positions.

5.4.3. The positions were written into a max script which automated the animation and movement of each unit in 3D Studio Max over OSGB mapping.

5.4.4. Lastly each unit was overlaid onto a mapping background and labelled to produce a complete animation of the GPS data available.

5.4.5. When viewing this data the following points should be considered.

(a) ARLS GPS 1 - in exterior settings 5 metres accuracy on top of the 2 metre conversion tolerance.
(b) Can be significantly worse indoors or heavily built up areas
(c) Linear transit between points, therefore greater tolerances in between points.
(d) Data not available for several vehicles in entirety
(e) Data of several people not available later in the events

5.4.6. The figure below, shows a screenshot from the final output.

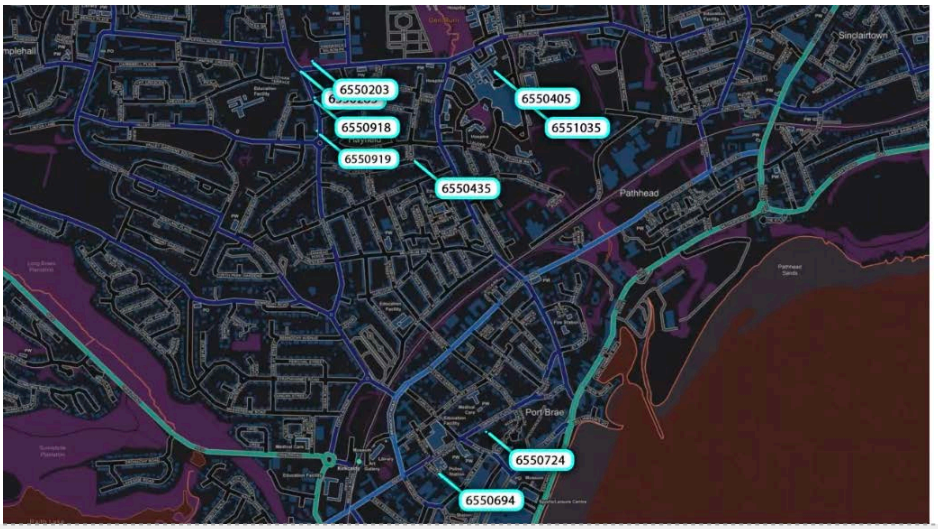


Figure 5.13 Output from ARLS animation

5.5. Tracking People and Vehicle Positions

5.5.1. PIRC-03371-SNAPCHAT 4027412658762379031

5.5.1.1. Observations

5.5.1.1.1. This has been identified as the earliest video showing the restraint. From the video one can see where the earliest police vehicles were parked. As well as the location of officers around Sheku Bayoh.

5.5.1.1.2. To help understand this video better, a version of the footage was created, however it was zoomed by 400% and stabilised around a fixed point (reference SBPI-00110).

5.5.1.1.3. The stabilised video was only possible to achieve whilst the mobile phone was pointed at the area of restraint, however it provides interesting points.

5.5.1.1.4. By going frame by frame through the video, Sheku Bayoh is not clearly visible or identifiable in this video at all. What can be seen is a minimum of six officers in the scene. Again the video is not clear enough for identification however it does give us clear insight into where each person was in the area of restraint.

5.5.1.1.5. The figure below highlights the individual police officers that can be seen.

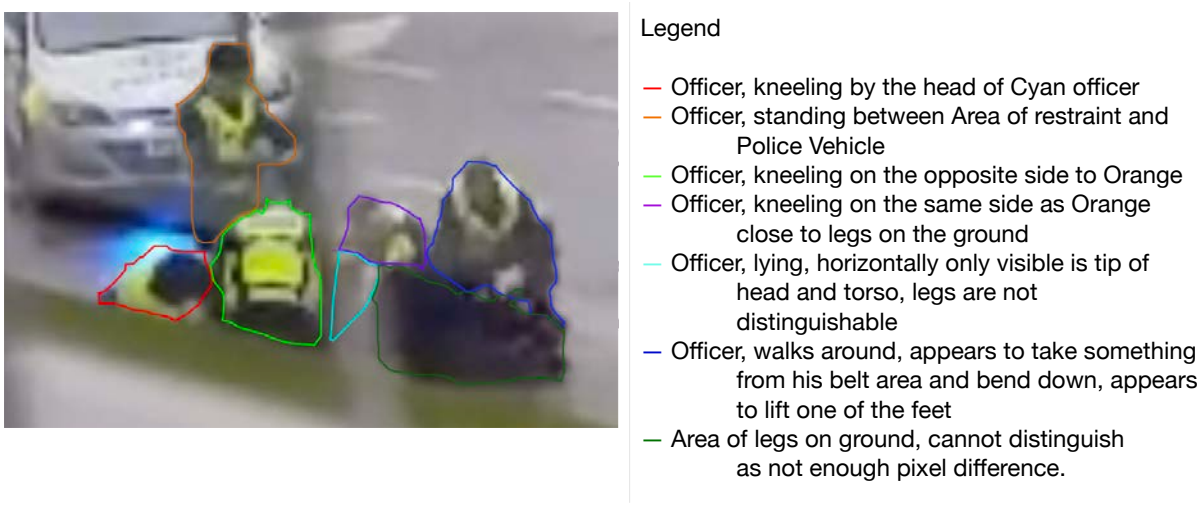


Figure 5.14 individual officers highlighted

5.5.1.1.6. The video is clear in showing the officers surrounding the people on the ground. In the footage three legs are clearly visible pointing towards the road, however clear identification is not possible due to the lack of variance in the pixel colour between the officers trousers/ shoes and those of Sheku Bayoh.

5.5.1.1.7.An Officer can be seen pulling what looks like a cord or similar from their belt area before kneeling down and manipulating a leg on the floor. The manipulation appears to lifting the leg up bending at the knee, this would indicate the person whose leg this is is facing downwards (prone).

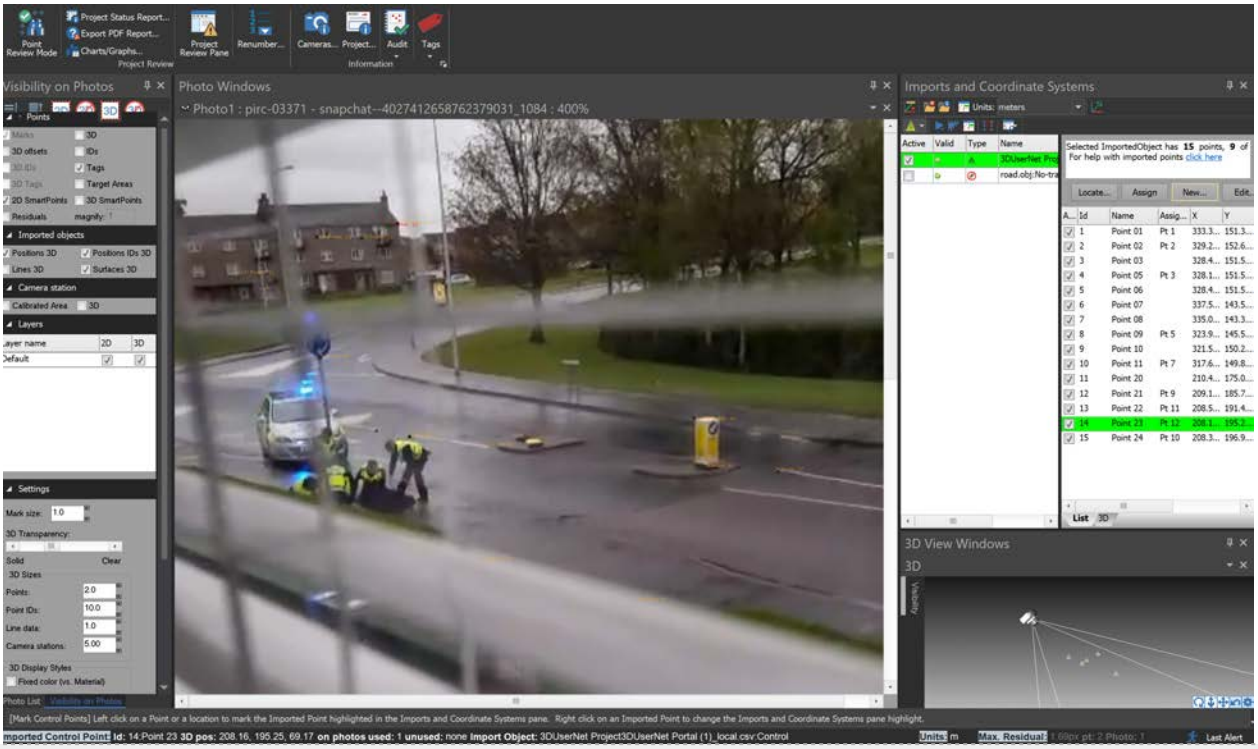
5.5.1.1.8.The Image below shows the leg manipulation, however it is recommended to view in the video to demonstrate this more clearly.

Figure 5.15 Manipulation of knee

5.5.1.2.Photogrammetry

5.5.1.2.1.Similar to the knife analysis, a photogrammetric analysis can be conducted on the snapchat footage to understand the position of the people and vehicles in the scene.

5.5.1.2.2.Firstly a single image is analysed to determine the camera calibration constants. Similar to the knife image analysed, the lens distortion is not significant from this image therefore fewer points can be used for the calibration. The image below show the image and the output.



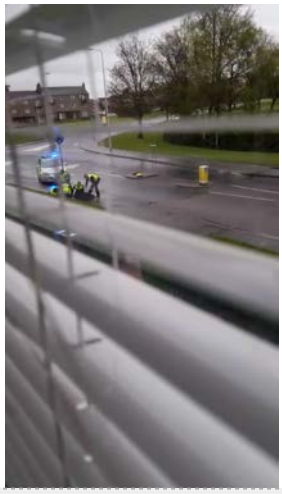
(a) Calibration set up

Calibration type	None
Focal length (mm)	7.22
Image size (pixels)	450 x 800
Format size (mm)	5.06 x 9
Principal point (mm)	2.35 x 5
Lens distortion (K)	K1[0.00759] K2[-0.000579] K3[0]
Lens distortion (P)	P1[0] P2[0]
Quality - Residuals	RMS[1.57] Max[3.16]
Quality - Coverage	26
Multispectral	No

(b) Camera Calibration exports

Figure 5.16 Camera Calibration

5.5.1.2.3. Once the camera calibration constants are determined, these can be applied to multiple images to determine the location and orientation of an image. Three images were selected for analysis which cover the scene as Ashley Wyse pans across.



(a) view toward restraint

(b) View across Hayfield Road

(c) View towards right of window.

Figure 5.17 Analysed images

5.5.1.2.4. Once these cameras have been assessed, positions of people and vehicles were marked out using contact points with the ground.

Figure 5.18 Ground marking positions identified

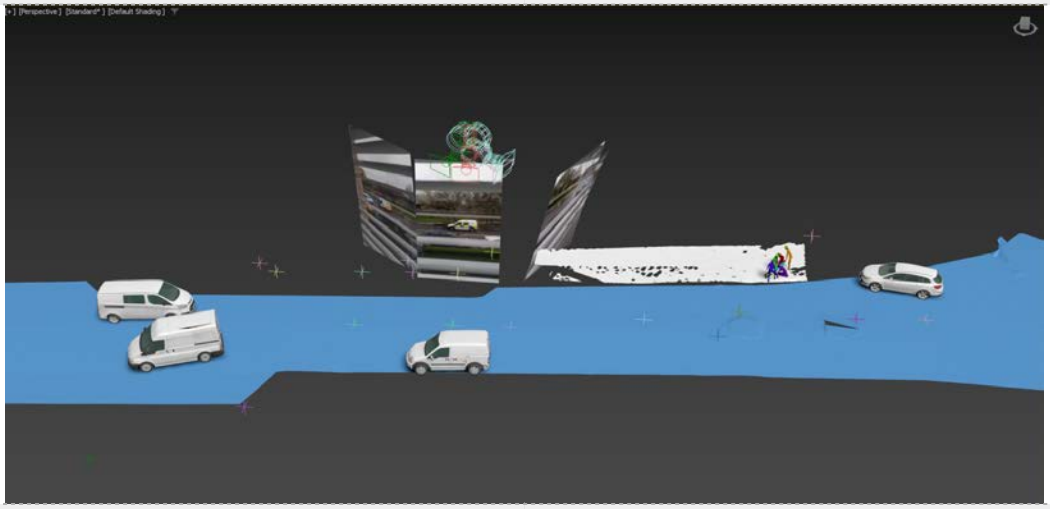
5.5.1.2.5. Police vehicle models and number plates were supplied within the ARLS material and verified using the number plates and DVLA database. These models were then purchased online from Hum3d. The models were then optimised to improve their performance on the cloud 3D interactive platform.

5.5.1.2.6.Models of vehicles and people were then added to scene using software package 3D Studio Max.

(a) Vehicle and People placement from Image 1

(b) Vehicle Placement from Image 2

(c) Vehicle Placement from Image 3



(d) Complete Modelled Scene

Figure 5.19 Models overlaid onto photography

5.5.1.2.7. It was observed that in placing the Ford Transit and the Ford connect that the models were different in length to the ones the police were using. The vehicles' models were adjusted to match the wheelbase and overall length of the vehicles.

5.5.1.2.8. Once these were created they could be added to the 2015 Hybrid model to view the scene in full.

(a) Overview Image from South Side

(b) Overview Image from North Side

(c) Model of Area of Restraint

Figure 5.20 Completed scene for PIRC-03371

5.5.2. PIRC-03370-SNAPCHAT 3800019487722441065 AND PIRC-03369-SNAPCHAT 2154007213033099882

5.5.2.1. The same process as above can be carried on PIRC-03370 and PIRC-03369 to produce 3D models of people and police vehicles in the scene at these times too.

(a) Restraint Image used

(b) Model of Area of Restraint

(c) Overview Image from South Side

(d) Overview Image from North Side

Figure 5.21 Placement of vehicles and people from PIRC-03370

(a) Restraint Image used

(b) Model of Area of Restraint

(c) Overview Image from South Side

(d) Overview Image from North Side

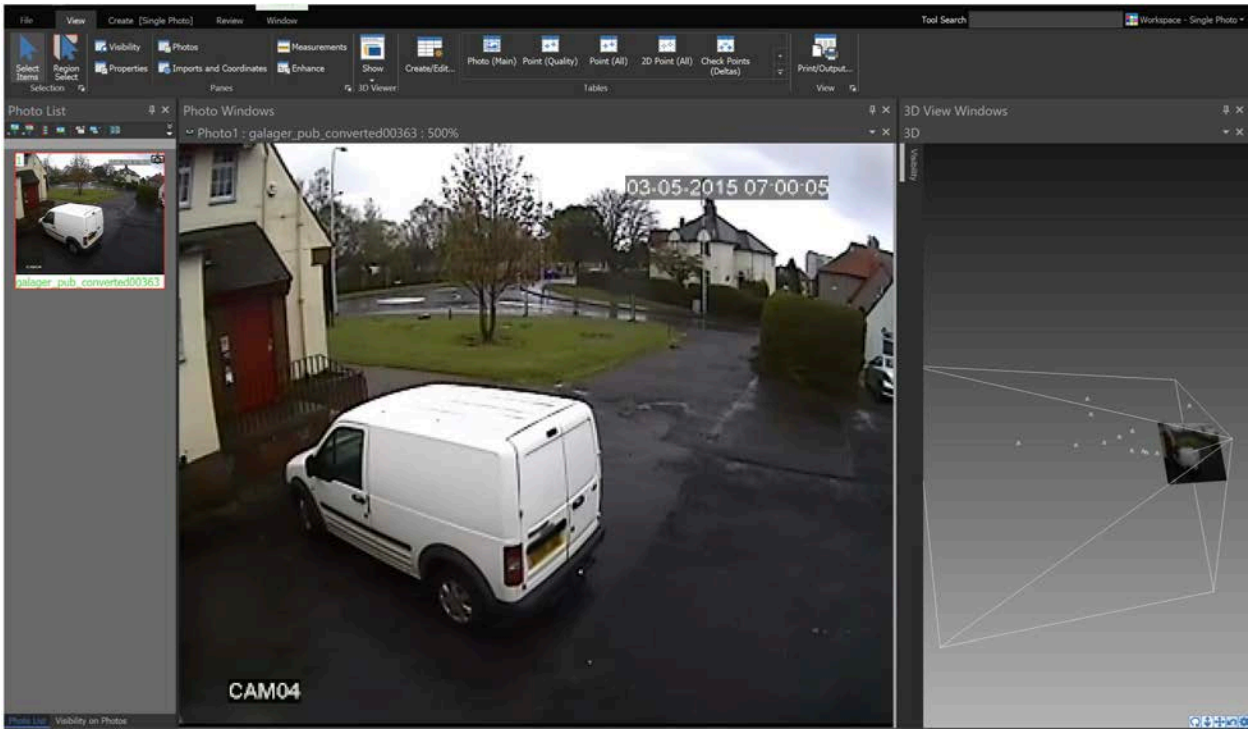
Figure 5.22 Placement of vehicles and people from PIRC-03369

5.5.3. GALLAGHERS PUBLIC HOUSE

5.5.3.1. The video from the Gallaghers Public House is difficult to understand from the point of view that there is so much happening all at once and it is easy to miss people and vehicles arriving and moving in the scene. By tracking the movements of vehicles and people where possible, this will add a level of understanding to the sequence of events beyond viewing the CCTV by itself.

5.5.3.2. As this is a static camera, once the camera position and orientation is known, this camera can placed into the scene and then vehicles and people can be animated.

5.5.3.3. The process is similar to the ones carried out above. Initially the camera is calibrated using a single image.



(a) screen shot of calibration

Calibration type	Field Calibration
Focal length (mm)	6.36
Image size (pixels)	352 x 288
Format size (mm)	9.58 x 7.36
Principal point (mm)	5.18 x 3.54
Lens distortion (K)	K1[0.000171] K2[0.000591] K3[0]
Lens distortion (P)	P1[0] P2[0]
Quality - Residuals	RMS[1.02] Max[2]
Quality - Coverage	26.7
Multispectral	No

(b) Calibration Constants

Figure 5.23 Initial Camera Calibration

5.5.3.4. Once the Camera is calibrated before bringing the solution into the 3D modelling package, the lens distortion must be removed. This was done using Adobe Aftereffects 2022 and the previously determined calibration constraints.

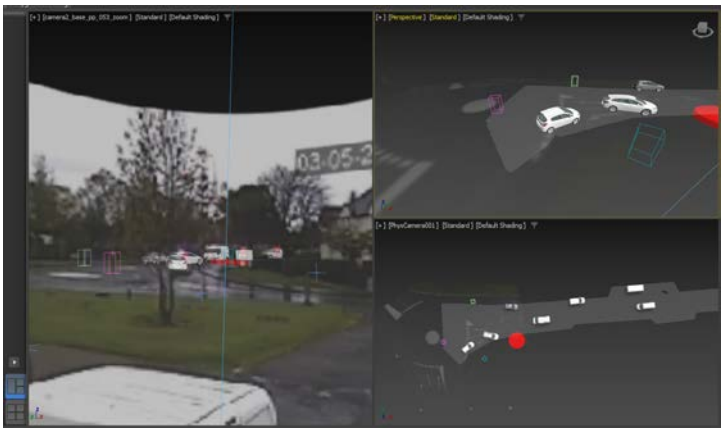
5.5.3.5. Once these images were created for the full sequence, the camera could be modelled in the 3D environment. Vehicle stop positions were taken from the snapchat analysis as this would be more precise, however the Gallagher footage was used to animate the entrance and exit of the police vehicles.

5.5.3.6. Movement of people were also tracked, however this was more limited due to the range of the people from the camera. It was also found that when several people were congregated in close proximity it was not possible to identify individuals.

5.5.3.7. Because of the range of distances from the camera, the placement of people can only be considered as an approximation with increasing error the further away from Gallaghers Public House.

5.5.3.8. Finally a birds eye view of people moving through the scene was rendered.

(a) Removing lens distortion



(b) Modelling of vehicles and people

(c) Top down render of people and vehicle movement.

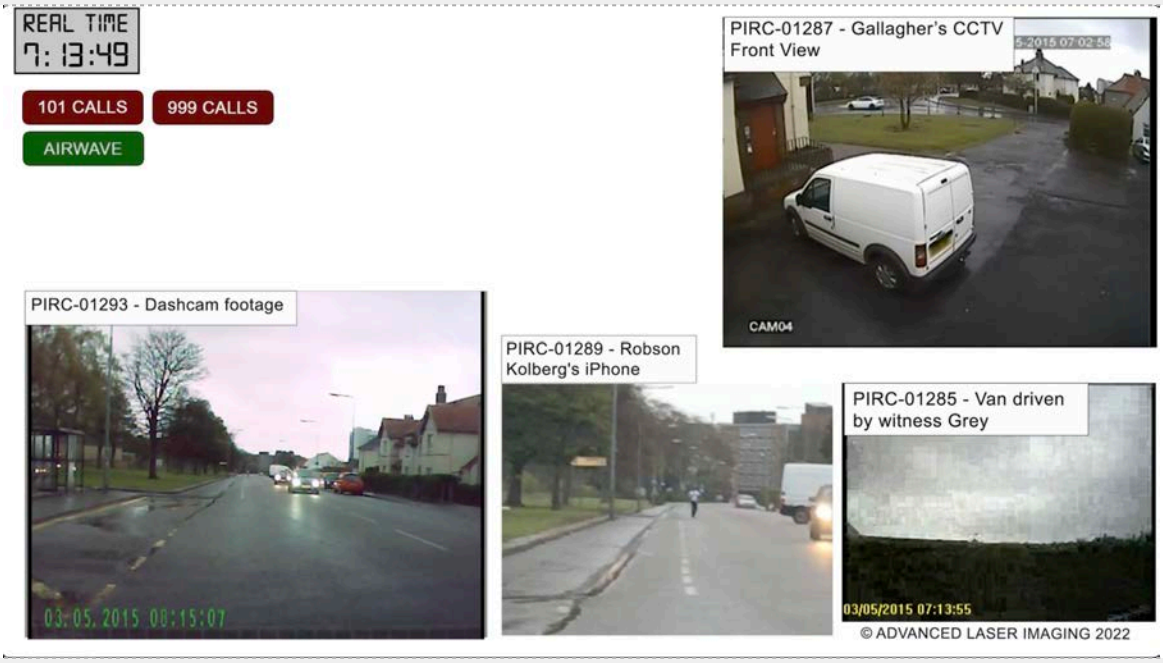
Figure 5.24 Production of vehicle/people movement from Gallagher's Public house footage.

5.6. Final Video Production

5.6.1. Most of the above elements were combined in a full video edit, with the real time clock played in the top left corner. Buttons were added to show when calls were made either via 999/101 or Airwave.

5.6.2. Lastly buttons were added to show when emergency buttons were pressed. The figure below show a few stills from the video. This video is referred to as the **Evidence Video Timeline (SBPI-00046)**

(a) screenshot at 07:11:07, 999 calls being made



Screenshot at 07:13:49, multiple sightings of Sheku Bayoh

(c) Screenshot at 07:22:15, multiple cameras and reconstruction running simultaneously

Figure 5.25 Combined Video edit of available material

5.7. 999 Transcripts

5.7.1. Advanced Laser Imaging were requested by the Inquiry to combine the Transcripts of the 999 calls together with start and end times for the calls. This was done using the video edit so each phone call could be isolated and the start and end times of the first and last phrase from the call could be identified. This was outputted as a Microsoft Excel spreadsheet.

6. ASSESSMENT OF SUBJECTIVE EVIDENCE

6.1. Methodology & Scope

6.1.1. The purpose of the subjective evidence assessment was to identify information that could be utilised for production of digital reconstructions for events that were being described by eye witnesses.

6.1.2. The material being considered encompassed numerous eye witness statements taken from both members of the public and police who attended or observed the scene during the intervention. The list of the statements considered can be found in section 3.3 (p20-21) of this report.

6.1.3. To conduct the assessment of the subjective evidence the methodology described in Appendix G was used. This was created to assist the Inquiry in understanding the process that ALI were adopting.

6.1.4. The methodology seeks to extract information from the statements in the form of temporal, spatial, person identification and object identification information.

6.1.5. This information can then be utilised to compare the statements and establish potential consistency or inconsistency in the descriptions of events. This can be done in relation to each other and/or the objective evidence, that can then define 'versions' that can be digitally reconstructed.

6.1.6. The analysis was conducted using a spreadsheet format on Apple Numbers and Microsoft Excel software. The original file created was in Numbers, utilised by ALI on Apple computer hardware and then exported to Excel format when issuing to the Inquiry due to Excel being the spreadsheet software used by the computer hardware available to the Inquiry.

6.2. Temporal Information Assessment

6.2.1. To conduct the temporal analysis for the statements, a common timeline for objective evidence that could be referenced against would be required. This would ensure that events being described, by the witnesses, could be reliably compared.

6.2.2.The real-time clock shown in the Evidence Video Timeline was utilised to provide this common timeline, as it included all of the relevant objective video and audio evidence in a single format.

6.2.3.After an initial overview of the statements it became clear that using the Airwave audio messages would be of benefit for determining the timing of events in the Police statements as they often referenced messages they were hearing or making on the Airwave system.

6.2.4.For the Public statements it was clear that using the video, especially from the Gallagher Public House and the Snapchat extracts, would be most beneficial to help determine the timing of events that they were describing, as they were not aware of the Airwave audio messages that were being made.

6.2.5.POLICE STATEMENT ANALYSIS

6.2.5.1.A spreadsheet was prepared in Apple Numbers software with the intention of using the information from the Airwave Transcript (PIRC-01399 - Transcript of Police Scotland Airwave Talkgroup Kirkcaldy 01) to create a timeline referencing the real-time clock against each message.

6.2.5.2.The Airwave Transcript was supplied to ALI as a pdf that appeared to be created from scanned images of an original document.

6.2.5.3.Adobe Acrobat software was used to import the pdf file and convert the images to editable text using a built in feature within the software that prompts to perform this action on import. This allowed the text to be manually copied from the pdf to the Numbers spreadsheet.

6.2.5.4. This process is not 100% reliable at converting each word correctly, and so a comparison was made visually to the original document to check for erroneous spellings or mistakes.

6.2.5.5.Columns were created in the spreadsheet for Real-Time clock timing, Audio Track Number, CallerID, Event (Message), Statement Information and Comment / Explanation of Placement.

Figure 6.1 Example of spreadsheet headings

Airwave Events and Transcript information taken from:
PIRC-01399 - PIRC010515 588 Transcript of Police Scotland Airwave Talkgroup Kirkcaldy 01 On 3rd May 2015 between 0616 and 08

Times taken from ALI Video Reconstruction

Timeline Template

Real Time (From Video reconstruction)	Track	Caller ID (Airwave Transcription)	Event (Airwave Transcription)	Stateme
07:16:22	1	Con 1	Control for ... four one Charlie	
07:16:29		P0691 PC Ashley Tomlinson	Go ahead	
07:16:32		Con 1	I need you to ... divert er. .. to Hendry Road a disturbance on-going, male armed with a knife .... African looking male chasing ..... someone ... may be carrying a knife .....described as big with muscles about six foot tall wearing a white t-shirt and dark coloured jeans there's another job coming in· about it, stand by	
07:16:59		P0691 PC Ashley Tomlinson	That's received Control is there other units that can assist us	

6.2.5.6. After transferring the text from the pdf to the spreadsheet an early version of the Evidence Video Timeline (Video and Audio overlay_c.mp4) was used to reference when each Airwave message was heard and the start time noted in the real-time clock column. This does not vary significantly from the final version of the Evidence Video Timeline created.

6.2.5.7. It was noted at this stage that there were some messages listed on the transcript that did not seem to have corresponding audio in the video. These were messages between 07.21.48 and 07.22.50 on the real-time clock and were messages allegedly made by PS Stephen Kay, DS Samantha Davidson and PC Craig Walker.

6.2.5.8. These audio clips were subsequently incorporated into a later version of the Evidence Video Timeline and times allocated as necessary.

6.2.5.9. The callerID field on the spreadsheet also had the names added where possible based on the descriptions given at the start of the PIRC Transcript.

6.2.5.10.There were a number of callerIDs that had not been identified in the PIRC Transcript. These were:

- SO307
- PO307
- PO919
- SD18
- A10
- PO394
- PO435
- Any Caller ID for Chief Inspector Stones

6.2.5.11. These missing callerIDs were raised with the Inquiry to establish if they were relevant and if names could be ascertained. Where the information was later made available and was deemed relevant the names were added to the spreadsheet.

6.2.5.12.The next stage of the assessment required reading through each Police eye witness statement and creating a separate sheet within the spreadsheet to record the temporal placements.

6.2.5.13.Using the Airwave transcript messages as an objective reference point, any messages or events that were referenced within the witness statement provided a moment that could be time linked and used as a 'fixed reference' point. The text was then copied from the statements into the spreadsheet between the previous fixed reference point and the message or event being described.

6.2.5.14.A separate column labelled 'Comments / Explanation of Placement' allowed recording of the reasons given for each placement, to allow it to be reviewed by the Inquiry and help avoid potential misinterpretation of the statement text.

6.2.5.15.The statements provided by DC Derek Connell were not included in this analysis due to very little information about Mr Bayoh and the intervention being identified on initial read through. The role of DC Connell appeared to be focussed on the recovery of the knife and batons that were at the scene and offered no descriptions on critical moments of the intervention.

6.2.5.16. After each statement had been analysed there were some potential discrepancies identified in the PIRC Transcript that were raised with the Inquiry for further information to be obtained. These were:

- There was mention over the airwave of an Emergency Button Activation in a message made at 07.20.56. However, it appeared from the statements that there had potentially been more than one Emergency Button Activation made by different persons. It was requested to obtain further information from the Airwave system data to understand the sequence and timing of the activations as this should have been recorded.
- The Transcript stated that the callerID for the message made at 07.21.02 regarding an officer being injured was made by PC Alan Smith, however, the statements implied this was more likely PC Alan Paton. It was requested whether this could be further clarified by the Inquiry.

6.2.5.17. The spreadsheet was exported to Microsoft Excel format (AudioTimeline.xlsx) and issued to the Inquiry for review to ascertain if any misinterpretation could be identified.

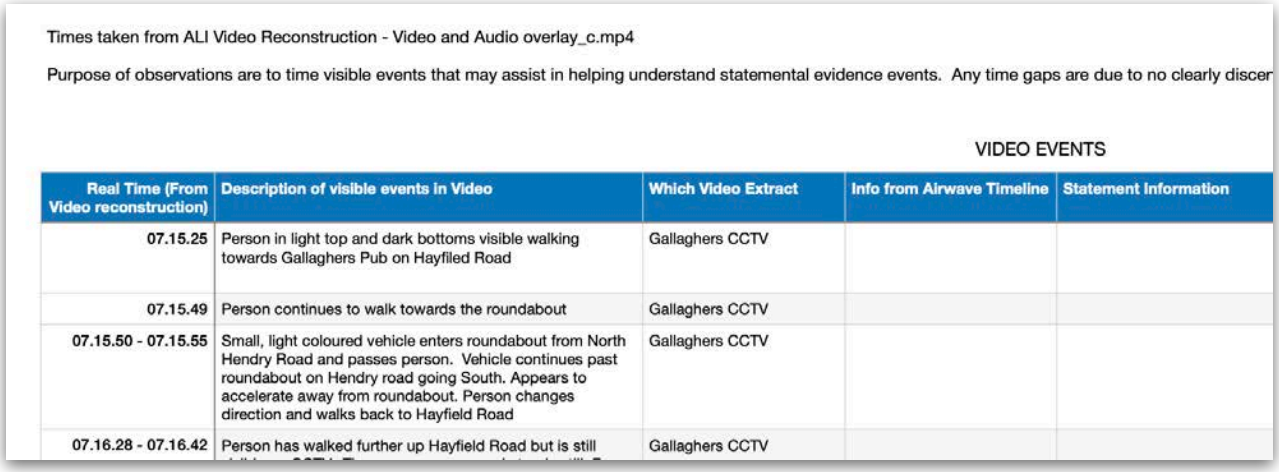
6.2.5.18. No changes were identified by the Inquiry at this time.

6.2.5.19. The Inquiry subsequently responded to both queries that had been raised and provided additional information that allowed the timing of the Emergency Button Activations to be incorporated and also that the message was indeed most likely made by PC Alan Paton and not PC Alan Smith. This information was updated in the spreadsheet.

6.2.6.PUBLIC STATEMENT ANALYSIS

6.2.6.1.For analysis of the Public statements a text description of events, visible in the Evidence Video Timeline, was required in order that objective events could be set against the real-time clock timings within the spreadsheet.

6.2.6.2.A new spreadsheet was created (VideoTimings.numbers) in Apple Numbers that had columns for Real-Time clock, Description of Events in the Video, Which Video Extract, Information from Airwave Timeline, Statement Information and Comment / Explanation of Placement.



Times taken from ALI Video Reconstruction - Video and Audio overlay_c.mp4

Purpose of observations are to time visible events that may assist in helping understand statemental evidence events. Any time gaps are due to no clearly discer

VIDEO EVENTS

Real Time (From Video reconstruction)	Description of visible events in Video	Which Video Extract	Info from Airwave Timeline	Statement Information
07.15.25	Person in light top and dark bottoms visible walking towards Gallaghers Pub on Hayfiled Road	Gallaghers CCTV		
07.15.49	Person continues to walk towards the roundabout	Gallaghers CCTV		
07.15.50 - 07.15.55	Small, light coloured vehicle enters roundabout from North Hendry Road and passes person. Vehicle continues past roundabout on Hendry road going South. Appears to accelerate away from roundabout. Person changes direction and walks back to Hayfield Road	Gallaghers CCTV		
07.16.28 - 07.16.42	Person has walked further up Hayfield Road but is still	Gallaghers CCTV		

Figure 6.2 Example of Spreadsheet Headings for VideoTimings.numbers

6.2.6.3. The Evidence Video Timeline was observed using Apple Quicktime Player software, which allowed frame by frame viewing and also efficient slow motion forward and backward playback.

6.2.6.4.Events that could be discerned from the video were described and noted in the spreadsheet. A note also being made of which footage / video extract was being specifically observed.

6.2.6.5.This process was carried out for approximately the same time period that was covered by the Airwave Transcript and ensuring that the intervention, up to the arrival of the Ambulance, was encompassed.

6.2.6.6.Each of the Public eye witness statements were then analysed against the descriptions and the video itself to help temporally align segments of the statement to events occurring in the video.

6.2.6.7.Each statement was analysed on a separate sheet within the spreadsheet and explanations entered in the Comment / Explanation of Placement sections for why each segment was placed at that time.

6.2.6.8.The statements of Abdeloouhab GUESSOUM and Sean MULLEN required more considered analysis to try to establish the vehicles that they had been driving through the scene. This analysis is detailed in Appendix H

6.2.6.9.The statement from Callum CRUICKSHANK was not used as the initial review of the statement identified that the witness states that they were not paying much attention and did not see the Police with anyone else. Furthermore, it did not provide clear enough detail to allow any reliable temporal alignment of the statement.

6.2.6.10.The statement from Pauline CRUICKSHANK was also not used as the initial review identified that the witness stated that they did not go to the window to view the incident and had stayed in bed.

6.2.6.11.After completing the statement analysis the spreadsheet was exported to Microsoft Excel format (VideoTimings.xlsx) and issued to the Inquiry for comment.

6.2.6.12.The Inquiry did not request any amendments to the temporal positions of the statements, however, it was requested that the Audio and Video timelines be combined into a single document for use by the Inquiry.

6.2.7. COMBINED AUDIO & VIDEO TIMELINE

6.2.7.1.In order to understand the Public and Police eye witness statements together in context of the real-time clock the two spreadsheets were combined into a new spreadsheet (Audio&VideoTimeline_Template Merged.numbers).

6.2.7.2.This new spreadsheet aligned the Audio and Video descriptions against the times for the real-time clock, effectively merging the information from both.

6.2.7.3.This new spreadsheet was exported to Microsoft Excel and issued to the Inquiry for comment.

6.2.7.4.At this stage it was also requested by ALI that the Inquiry review the Audio Transcript text against the audio files to ensure that the transcript fully reflected the wording actually used. This analysis was beyond the expertise of ALI, and required knowledge of the local dialect of persons making the audio messages.

6.2.7.5.The inquiry responded with suggested amendments to the Audio Transcript.

6.2.7.6.These amendments primarily focussed on replacement of text characters that represented inaudible sounds with the description of [inaudible], but also some alterations to particular words in messages.

6.2.7.7.Of particular note was the phrase used by PC Alan Paton at 07.21.02. Initially this read 'Officer down .. PC Short .. male #### ', but after consideration by the Inquiry was amended to 'Officer's injured PC Short male'

6.2.7.8.The suggested amendments were further discussed at a Microsoft Teams meeting with the Inquiry on 28th March 2022, and the agreed amendments were made to the Audio Transcript information in the spreadsheet.

6.2.7.9.The Inquiry also requested that some additional video description information be added to the start of the spreadsheet to cover the moments recorded by the dash cam footage as the spreadsheet would likely be a very useful reference for the Inquiry during proceedings.

6.2.7.10.ALI requested that the Inquiry provide the details for this time period as it was outside the scope of the digital reconstruction aspect. The Inquiry provided the information and a separate spreadsheet was created to incorporate this and issued as (Audio&VideoTimeline_CounselVersion.xlsx) after exporting it to Microsoft Excel format.

6.2.7.11.All of the analysed statements were then aligned against the Audio / Video timeline, each on a separate sheet retaining the explanatory comments, and then also combined into a single sheet at the front of the spreadsheet, where a column was dedicated for each statement. This allowed for effective printing of all of the statements in temporal alignment.

6.2.7.12.This spreadsheet (Audio&VideoTimeline_StatementAnalysis.numbers) was exported to Microsoft Excel format

(Audio&VideoTimeline_StatementAnalysis_Temporal.xlsx) and issued to the Inquiry for further review .

6.2.7.13. The Inquiry did not recommend any further changes to the spreadsheet.

6.3. Spatial / Person & Object Identification Information Assessment

6.3.1. The Inquiry provided instruction during a Microsoft Teams meeting on 19th April 2022 that the time period of critical importance was between 07.19.54 and 07.25.17 which encompassed the first arrival of Police at the scene to when declaration was made that Mr Bayoh had become unconscious and required an ambulance.

6.3.2. This time period was identified in the spreadsheet and all overlapping segments of the statements for both Public and Police eye witnesses were identified using a pastel green cell background.

6.3.3. Each statement segment that had been identified was then analysed for the Spatial / Person and Object information and text that related to these was highlighted in separate colours.

6.3.4. The colour coding used on the spreadsheet to highlight the different information was as follows:

- **Spatial Information** was coloured Light Blue
- **Person Identification** Information was coloured Orange
- **Object Identification** Information was coloured Purple
- **External Documentation References** were coloured Purple

6.3.5. The analysed spreadsheet was then reissued to the Inquiry (Audio&VideoTimeline_StatementAnalysis_v2.xlsx) for further consideration and derivation of ‘versions’ that would be required.

6.4. Version Identification

6.4.1. The Inquiry provided further instruction on 27th April 2022 describing the events that were considered critical for reconstruction and where different versions of the evidence existed.

6.4.2.The critical events described were:

- The alleged stomp / no stomp on PC Nicole Short
- The restraint of Sheku Bayoh

6.4.3.An Apple Pages document (Versions01.pages) was prepared that took extracts relating to these events from the statements that had been analysed in the spreadsheet and listed them for each eye witness.

6.4.4.Also included in the document was any information from annotated productions that had been referenced by the relevant witnesses that appeared to relate to the same events. This was in the form of labelled mapping or satellite imagery.

6.4.5.This information was used in combination with the Objective scene reconstruction to produce an initial interpretation of the stomp / no stomp event.

6.4.6.A meeting was held with the Inquiry on 5th May 2022 to review this initial interpretation and discuss the limitations of the information available from the statements in terms of orientation and placement of individuals for this event.

6.4.7.A decision was made by the Inquiry that further evidence would be requested from each of the witnesses during the inquiry proceedings that could then be incorporated with the historical statements to further understand the events.

6.5. Further Evidence Material

6.5.1.Due to the eye witnesses making themselves available to the Inquiry for further questioning there will be an opportunity to request further clarification for events they witnessed.

6.5.2.To support this process and attempt to gather best evidence some additional products were prepared for the Inquiry.

6.5.3. ALLEGED STOMP / NO STOMP EVENT

6.5.3.1.For use during questioning regarding the alleged stomp / no stomp event an interactive version of the objective 3D scene will be utilised. This will locate vehicles within the scene as positioned using the analysis from the first snapchat video captured by Ashley Wyse and verified in the Gallaghers Public House CCTV.

6.5.3.2.The witness will be asked to place persons involved in the event at locations that they can recall.

6.5.3.3.The interactive 3D scene will be hosted on the 3DUserNet VISION platform and a member of ALI will be present during the questioning to navigate the scene and place models of people within the scene as directed by the witness.

6.5.3.4.The resulting reconstruction will be saved for each witness' version of events.

6.5.4.RESTRAINT OF MR BAYOH

6.5.4.1.During questioning regarding the restraint of Mr Bayoh a series of still images from the 3D Scene will be used, alongside the analysis of persons within the scene as positioned using the analysis from the first snapchat video captured by Ashley Wyse.

6.5.4.2.The witness will be asked to locate and identify individuals at various points throughout the process of restraint using the courtroom technology.

6.5.4.3.In regards to Mr Bayoh they will also be asked to clarify the pose, whether prone, supine, on his side or another configuration.

6.5.4.4.The resulting marked-up images will be saved for each witness.

APPENDIX A - OUTLINE OF PROPOSAL

Sunday, 14 November 2021

Sheku Beyoh Inquiry - Digital Reconstruction

The headings below describe the proposed stages for the reconstruction based on the currently available evidence.

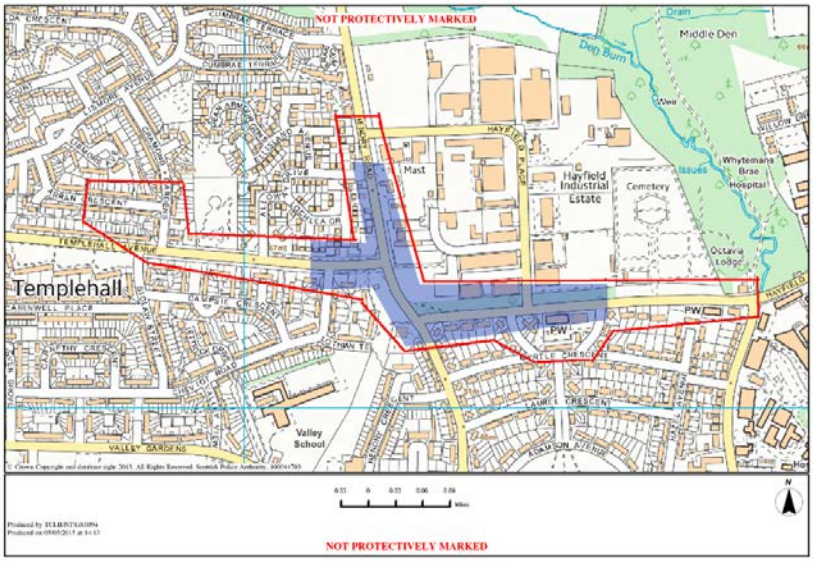
1 - Timeline Preparation

After review of the evidence it appears that the **Airwave** audio clips and **999 call** clips provide reliable timings and an almost continuous thread throughout the duration of the incident. Therefore, we propose to construct a single timeline of this material to which other evidence, such as the **Dashcam** footage and **CCTV** may also be aligned. We will also attempt to align the **Snapchat** video based on any additional meta data or visible information.

This product would most likely take the form of a video in order to have the audio and video sequenced together. This could be a standalone product in its own right.

2 - 3D Survey

We propose conducting a 3D Laser Scan and Photogrammetric survey of the area to produce a reliable framework for overlay of the other available evidence from the scene. The survey will provide accurate measurement and scale information that will allow analysis to be conducted on the photographic and video evidence.



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Of particular importance to capture are the areas of the Gallagher Public House where the CCTV was recorded and also the streets where Dashcam footage was obtained. The survey will also collect information of the properties surrounding the area of the incident in order that witness positions can be evaluated.

We are still awaiting delivery of scan data that was collected by the Police, however this may not cover the full scope of the incident. It should, however, provide reliable evidence for the main locale and can be integrated with the additional survey data collected.

3 - CCTV / Snapchat / Dashcam Video Analysis

The CCTV, Snapchat and Dashcam video will be photogrammetrcially overlaid onto the 3D survey to analyse the placement of persons and vehicles recorded within the footage. When referenced to the timeline this will further provide evidence of the sequence of movement during the incident.

4 - Evidence Marker / Evidential Photography Placement

Using the imagery available from the post incident evidential collection by the Police these images will be overlaid photogrammetrically onto the 3D survey to place objects and vehicles within the scene. This will represent a later part of the timeline but the placement of the objects will be relevant to understand in relation to the other video and statemental evidence.

5 - Statement Overlays

Given the mapping that has been provided with some of the statements it will be possible to overlay this information into the 3D survey data to further understand the statements. This is recommended to be conducted for individual statements at this stage. This will be done with scaled objects to represent the relative locations of persons and vehicles marked.
This information may relate to several parts of the timeline, as it is likely that descriptions given are not as constrained as other information available.

6 - Further Statement Evaluation

After the previous stages are complete we will conduct a review of the written statements in more detail to understand the location of people at times in between those identified by the other evidence available.

This stage will include identifying concurrent events between statements and their approximate location within the 3D scene.

APPENDIX B - MATERIAL RELIED UPON

Doc ID	Description
PIRC-00019	PIRC-00019 - S008 Kevin NELSON
PIRC-00043	PIRC-00043 - S020 - Ashley WYSE
PIRC-00044	PIRC-00044 - S020A Ashley WYSE
PIRC-00047	PIRC-00047 - S022 - Derek CONNELL
PS00757	PS00757 D209 A369 Copy Op Birnie statement DC Derek CONNELL S18 (SCD HOLMES)
PIRC-00056	PIRC-00056 - S028 Hazel SINCLAIR
PIRC-00057	PIRC-00057 - S028A Hazel SINCLAIR
PIRC-00075	PIRC-00075 - S044 Abdeloouhab GUESSOUM
PIRC-00084	PIRC-00084 - S051 Akhtar ALI
PIRC-00117	PIRC-00117 - S080 Danny ROBINSON
PIRC-00120	PIRC-00120 - S082 Sean MULLEN
PIRC-00129	PIRC-00129 - S089 DC Brian ONEILL
PIRC-00176	PIRC-00176 - S125A DC Fiona MCEWAN
PS00379	PS00379 D291 A356 Copy statement S130 Samantha Davidson (Legal 2)
PIRC-00185	PIRC-00185 - S130B - DS Samantha DAVIDSON
PIRC-00223	PIRC-00223 - S151A DCI Colin ROBSON
PS00280	PS00280 D114 A356 Copy statement S151 Colin ROBSON (legal 2)
PIRC-00251	PIRC-00251 - S173 Christopher FENTON
PIRC-00253	PIRC-00253 - S175 PC Nicole Short
PIRC-00254	PIRC-00254 - S175A PC Nicole SHORT
PIRC-00258	PIRC-00258 - S177 PC Daniel GIBSON
PIRC-00262	PIRC-00262 - S180 PC Alan PATON
PIRC-00263	PIRC-00263 - S181 PC Ashley TOMLINSON
PIRC-00264	PIRC-00264 - S182 PC Craig WALKER
PIRC-00265	PIRC-00265 - S182A PC Craig WALKER
PIRC-00266	PIRC-00266 - S183 - Scott MAXWELL
PIRC-00267	PIRC-00267 - S183A PS Scott MAXWELL
PIRC-00273	PIRC-00273 - S187 James MCDONOUGH
PIRC-00274	PIRC-00274 - S188 PC Kayleigh GOOD
PIRC-00278	PIRC-00278 - S190 PC Alan SMITH
PIRC-00308	PIRC-00308 - S212 Callum CRUICKSHANK
PIRC-00312	PIRC-00312 - S216 Pauline CRUICKSHANK
PIRC-00327	PIRC-00327 - S228 John WILSON
PIRC-00507	PIRC-00507 - S376 Colin GILL
COPFS-05956	COPFS-05956 - PRO 450- SATALITE VIEW OF HAYFIELD ROAD, HENDRY ROAD KIRKCALDY AND MAP OF HAYFIELD ROAD (DODD + ROONEY)
COPFS-05957	COPFS-05957 - PRO 452- SATALITE VIEW OF HAYFIELD ROAD, HENDRY ROAD KIRKCALDY AND MAP OF HAYFIELD ROAD (FERGUSON + HEADRICK)

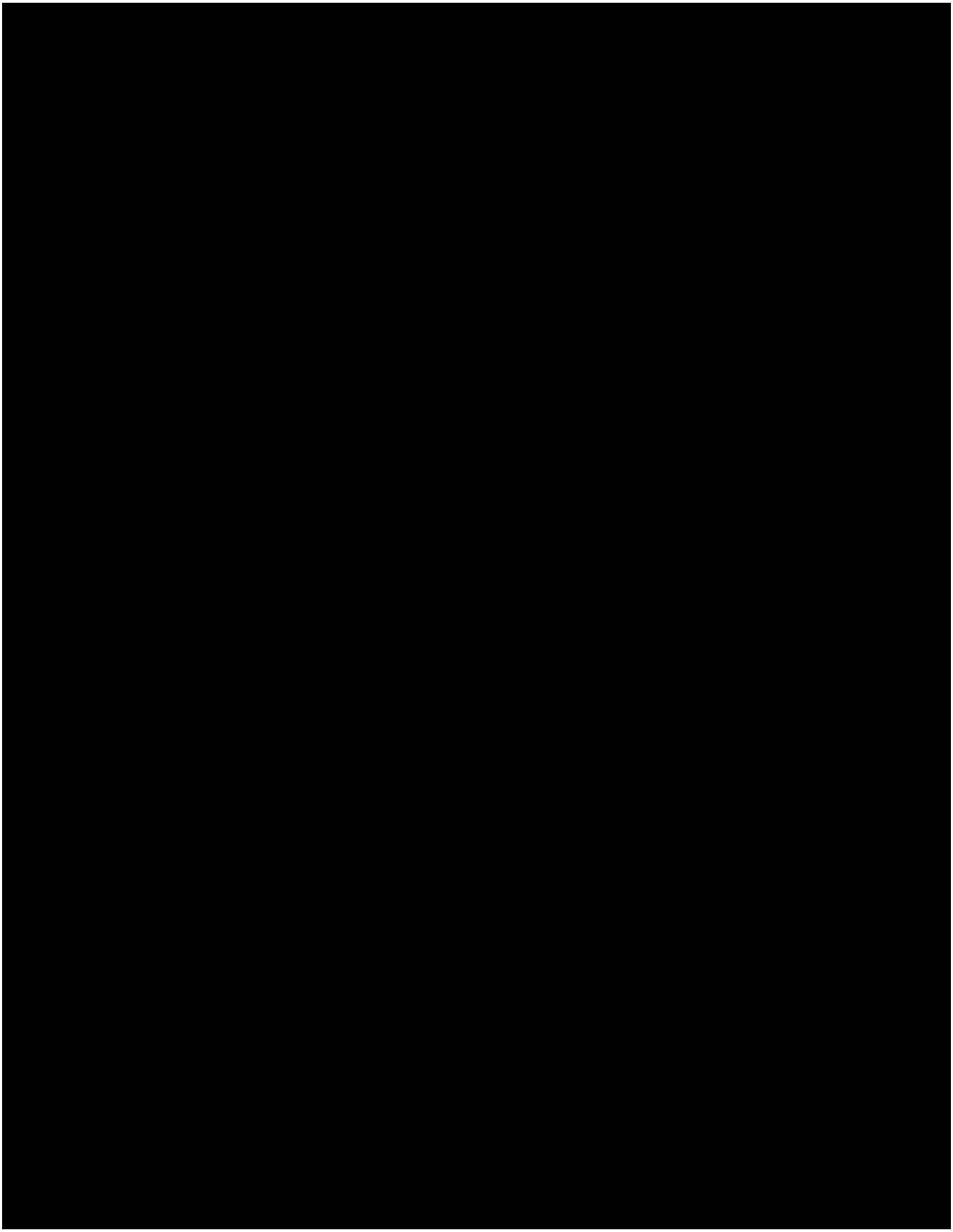
COPFS-05959	COPFS-05959 - PRO 460- SATALITE VIEW OF HAYFIELD ROAD, HENDRY ROAD KIRKCALDY AND MAP OF HAYFIELD ROAD (RHODES + PATTENDEN)
COPFS-05962	COPFS-05962 - PRO 469- SATALITE VIEW OF HAYFIELD ROAD + HENDRY ROAD KIRKCALDY AND MAP OF HAYFIELD ROAD + HENDRY ROAD, KIRKCALDY
COPFS-05965	COPFS-05965 - PRO 454- SATALITE VIEW OF HAYFIELD ROAD, HENDRY ROAD KIRKCALDY AND MAP OF HAYFIELD ROAD (HARROWER + UNGI)
COPFS-05966	COPFS-05966 - PRO 458- SATALITE VIEW OF HAYFIELD ROAD, HENDRY ROAD KIRKCALDY AND MAP OF HAYFIELD ROAD (SINCLAIR + DAVIDSON)
COPFS-00088	COPFS-00088 Pro 439 - Aerial Photograph and Map of Area Around Locus
COPFS-00089	COPFS-00089 Pro 441 - 2 Google Maps of Hayfield Road at Hendry Road Kirkcaldy
COPFS-00091	COPFS-00091 Pro 447 - Satellite View of Hayfield Road Hendry Road Kirkcaldy and Map of Hayfield Road (Taylor Stewart)
COPFS-00098	COPFS-00098 Pro 464 - Satellite View of Hayfield Road Hendry Road Kirkcaldy and Map of Hayfield Road (McGuireCasey)
COPFS-00099	COPFS-00099 Pro 466 - Satellite View of Hayfield Road Hendry Road Kirkcaldy and Map of Hayfield Road (BonnerMiles)
PIRC-01058	PIRC-01058 - PIRC010515 247 MAP INDICATING APPROXIMATE LOCATION OF KNIFE RECOVERED BY DC DEREK CONNELL
PIRC-03374	PIRC-03374 - ID OF OFFICERS AT SCENE PER DS DAVIDSON
PIRC-01155	PIRC-01155 - PIRC010515.344 Leica TruView 3D Scan
PS17473	PS17473 D13299 33 95 516.55 ARLPlot_Hayfield_Road (Donaldson)
PS17472	PS17472 D13296 33 95 516.57 MapPlots (Donaldson)
PIRC-03527	PIRC-03527 - 6550203data
PIRC-03528	PIRC-03528 - 6550285 data
PIRC-03529	PIRC-03528 - 6550349 data
PIRC-03530	PIRC-03530 - 6550374 data
PIRC-03531	PIRC-03531 - 6550405 data
PIRC-03532	PIRC-03532 - 6550435 data
PIRC-03533	PIRC-03533 - 6550465 data
PIRC-03534	PIRC-03534 - 6550523 data
PIRC-03535	PIRC-03535 - 6550691 data
PIRC-03536	PIRC-03536 - 655094 data
PIRC-03537	PIRC-03537 - 6550724 data
PIRC-03538	PIRC-03538 - 6550918 data
PIRC-03539	PIRC-03539 - 6550919 data
PIRC-03540	PIRC-03540 - 6551014 data
PIRC-03541	PIRC-03541 - 6551035 data
PIRC-03542	PIRC-03542 - 6550203 data plot numbering
PIRC-03543	PIRC-03543 - 6552017 data
PIRC-03546	PIRC-03546 - Hospital All ISSI filtered by road
PIRC-03548	PIRC-03548 - Vic Hospital All P Div
COPFS-00170	COPFS-00170 - Pro 839 - 2158 All Call Types 20150503 PD4470

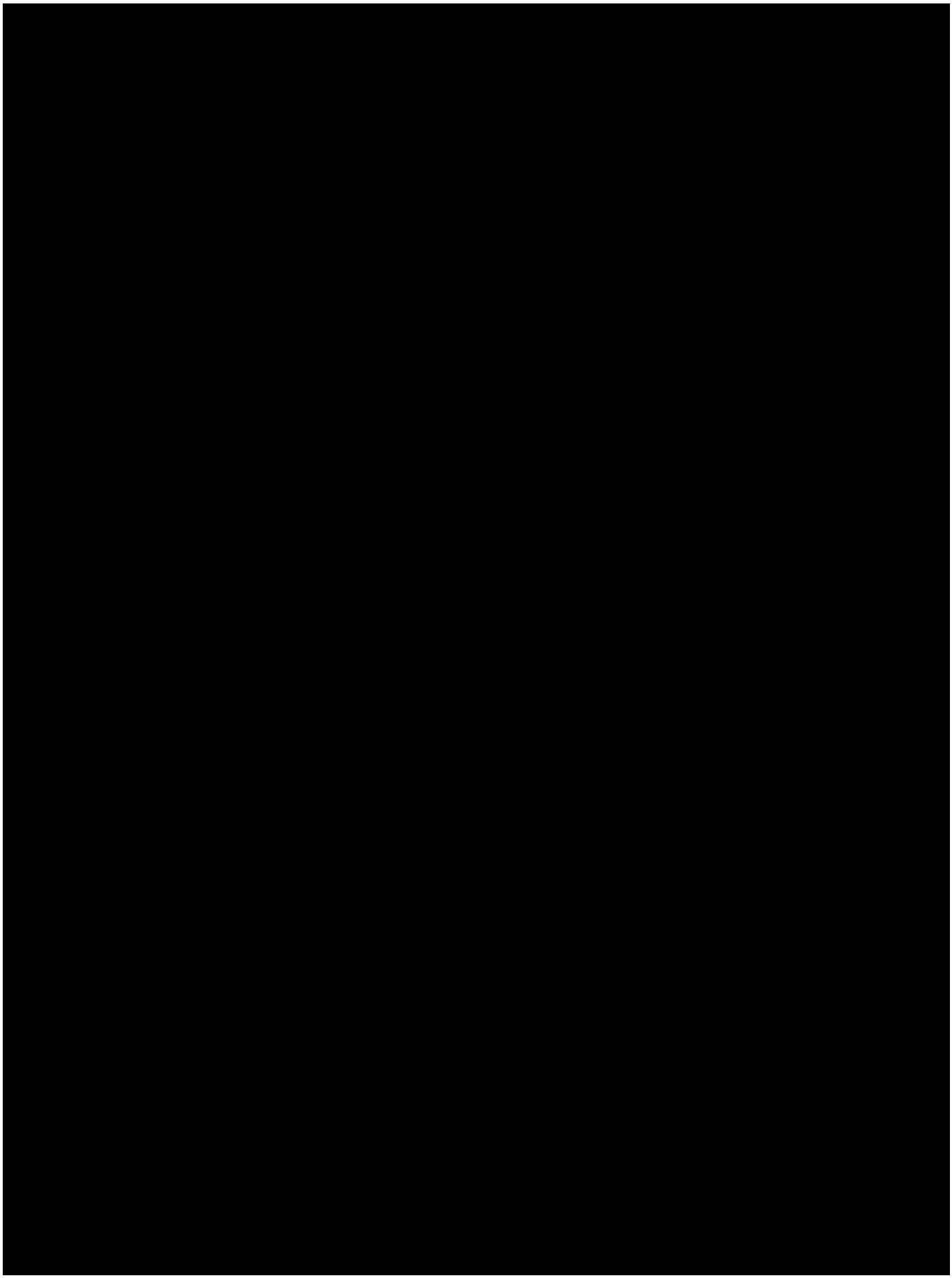
PIRC-04514	PIRC-04514 Operation Quoich Report on Snapchat and WhatsApp timestamps variances
PIRC-03838	PIRC-03838 - Airwave Overview - PIRC - Feb 2018
COPFS-05967	COPFS-05967 - PRODUCTION 320
PS00181	PS00181 D1393 A370 2015011305-SPADVD08893-PDF FOR PIRC (Legal 1)
PS13559	PS13559 D10694 33 25 1 14a (from T6842) image of knife at scene (Connell)
PIRC-01399	PIRC-01399 - PIRC010515 588 Transcript of Police Scotland Airwave Talkgroup Kirkcaldy 01 On 3rd May 2015 between 0616 and 0800 GMT
PS02328	PS02328 11. 32631150
PS02329	PS02329 12. 32631190
PS13674	PS13674 D10648 03052015 0716 hrs 13 182 15 Transmission 32630857 Kdy TG (C3)
PS13675	PS13675 D10649 03052015 0717 hrs 13 182 16 Transmission 32630869 Kdy TG (C3)
PS13676	PS13676 D10650 03052015 0718 hrs 13 182 17 Transmission 32630891 Kdy TG (C3)
PS13677	PS13677 D10651 03052015 0719 hrs 13 182 18 Transmission 32630902 Kdy TG (C3)
PS13678	PS13678 D10652 03052015 0719 hrs 13 182 19 Transmission 32630929 Kdy TG (C3)
PS13679	PS13679 D10653 03052015 0720 hrs 13 182 20 Transmission 32630931 Kdy TG (C3)
PS13680	PS13680 D10654 03052015 0720 hrs 13 182 21 Transmission 32630955 Kdy TG (C3)
PS13681	PS13681 D10655 03052015 0721 hrs 13 182 22 Transmission 32630971 Kdy TG (C3)
PS13682	PS13682 D10656 03052015 0721 hrs 13 182 23 Transmission 32630991 Kdy TG (C3)
PS13683	PS13683 D10657 03052015 0722 hrs 13 182 24 Transmission 32630999 Kdy TG (C3)
PS13684	PS13684 D10658 03052015 0722 hrs 13 182 25 Transmission 32631014 Kdy TG (C3)
PS13685	PS13685 D10659 03052015 0723 hrs 13 182 26 Transmission 32631025 Kdy TG (C3)
PS13686	PS13686 D10660 03052015 0724 hrs 13 182 27 Transmission 32631036 Kdy TG (C3)
PS13687	PS13687 D10661 03052015 0725 hrs 13 182 28 Transmission 32631048 Kdy TG (C3)
PS13688	PS13688 D10662 03052015 0726 hrs 13 182 29 Transmission 32631075 Kdy TG (C3)
PS13689	PS13689 D10663 03052015 0726 hrs 13 182 30 Transmission 32631086 Kdy TG (C3)
PS13690	PS13690 D10664 03052015 0727 hrs 13 182 31 Transmission 32631103 Kdy TG (C3)

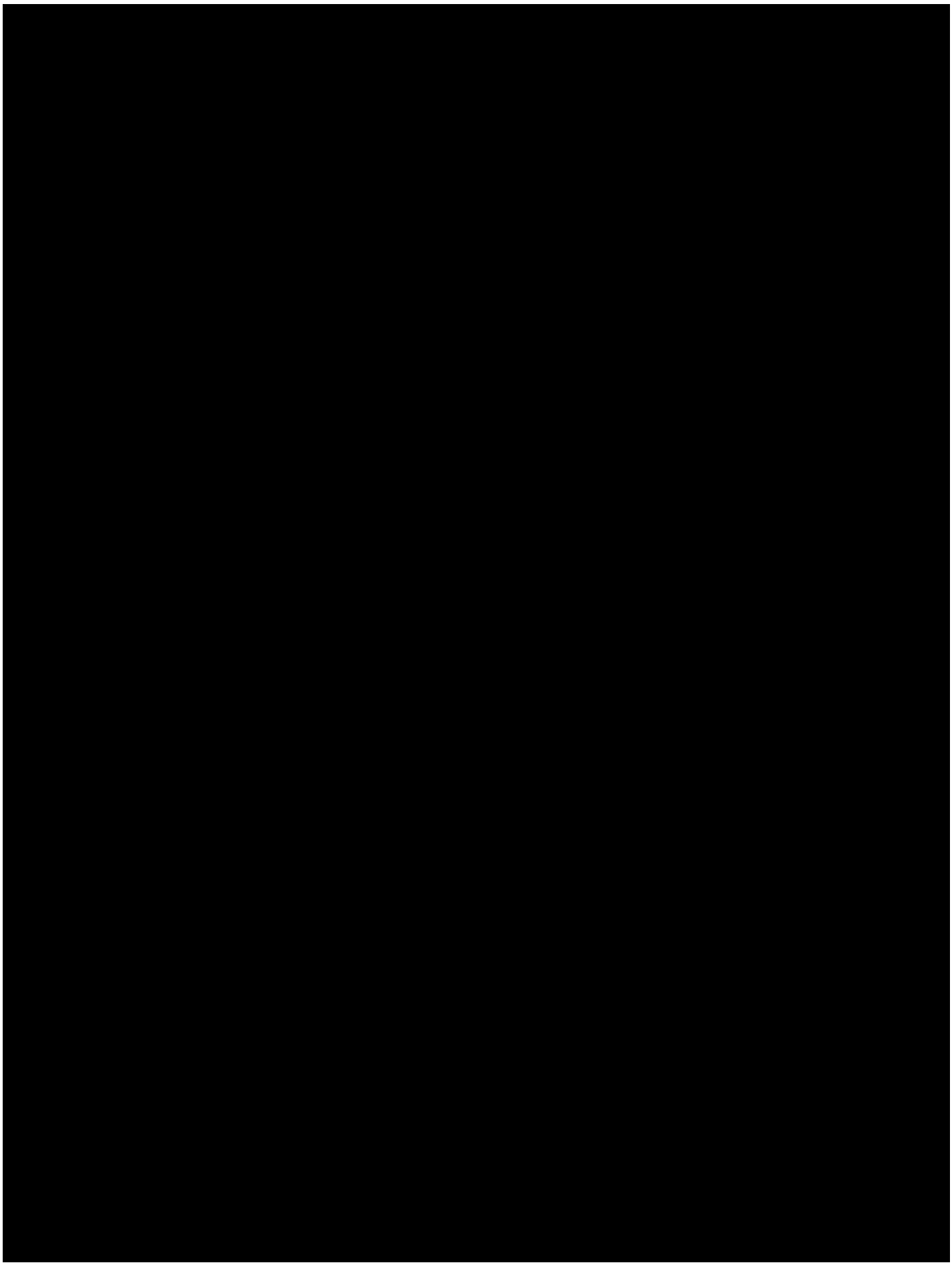
PS13691	PS13691 D10665 03052015 0727 hrs 13 182 32 Transmission 32631113 Kdy (C3)
PS13692	PS13692 D10666 03052015 0728 hrs 13 182 33 Transmission 32631137 Kdy TG (C3)
PS13693	PS13693 D10667 03052015 0728 hrs 13 182 34 Transmission 32631141 Kdy TG (C3)
PS13694	PS13694 D10668 03052015 0728 hrs 13 182 35 Transmission 32631149 Kdy TG (C3)
PS13695	PS13695 D10669 03052015 0729 hrs 13 182 36 Transmission 32631169 Kdy TG 03052015 (C3)
PS13696	PS13696 D10670 03052015 0729 hrs 13 182 37 Transmission 32631170 Kdy TG (C3)
PS13697	PS13697 D10671 03052015 0729 hrs 13 182 38 Transmission 32631175 Kdy TG (C3)
PS13698	PS13698 D10672 03052021 0729 hrs 13 182 39 Transmission 32631188 Kdy TG (C3)
PS13699	PS13699 D10673 03052015 0730 hrs 13 182 40 Transmission 32631207 Kdy TG (C3)
PS13700	PS13700 D10674 03052015 0730 hrs 13 182 41 Transmission 32631220 Kdy TG (C3)
PS13701	PS13701 D10675 03052015 0731 hrs 13 182 42 Transmission 32631262 Kdy TG (C3)
PS13702	PS13702 D10676 03052015 0732 hrs 13 182 43 Transmission 32631267 Kdy TG (C3)
PS13703	PS13703 D10677 03052015 0733 hrs 13 182 44 Transmission 32631274 Kdy TG (C3)
PS13704	PS13704 D10678 03052015 0733 hrs 13 182 45 Transmission 32631304 Kdy TG (C3)
PS13705	PS13705 D10679 03052015 0735 hrs 13 182 46 Transmission 32631363 Kdy TG (C3)
PS13706	PS13706 D10680 03052015 0735 hrs 13 182 47 Transmission 32631385 Kdy TG (C3)
PS13707	PS13707 D10681 03052015 0736 hrs 13 182 48 Transmission 32631405 Kdy TG (C3)
PS13708	PS13708 D10682 03052015 0736 hrs 13 182 49 Transmission 32631411 Kdy TG (C3)
PS13709	PS13709 D10683 03052015 0737 hrs 13 182 50 Transmission 32631428 Kdy TG (C3)
PS13710	PS13710 D10684 03052015 0738 hrs 13 182 51 Transmission 32631461 Kdy TG (C3)
PS13711	PS13711 D10685 03052015 0739 hrs 13 182 52 Transmission 32631471 Kdy TG (C3)
PS13712	PS13712 D10686 03052015 0740 hrs 13 182 53 Transmission 32631483 Kdy TG (C3)
PS13713	PS13713 D10687 03052015 0741 hrs 13 182 54 Transmission 32631504 Kdy TG (C3)

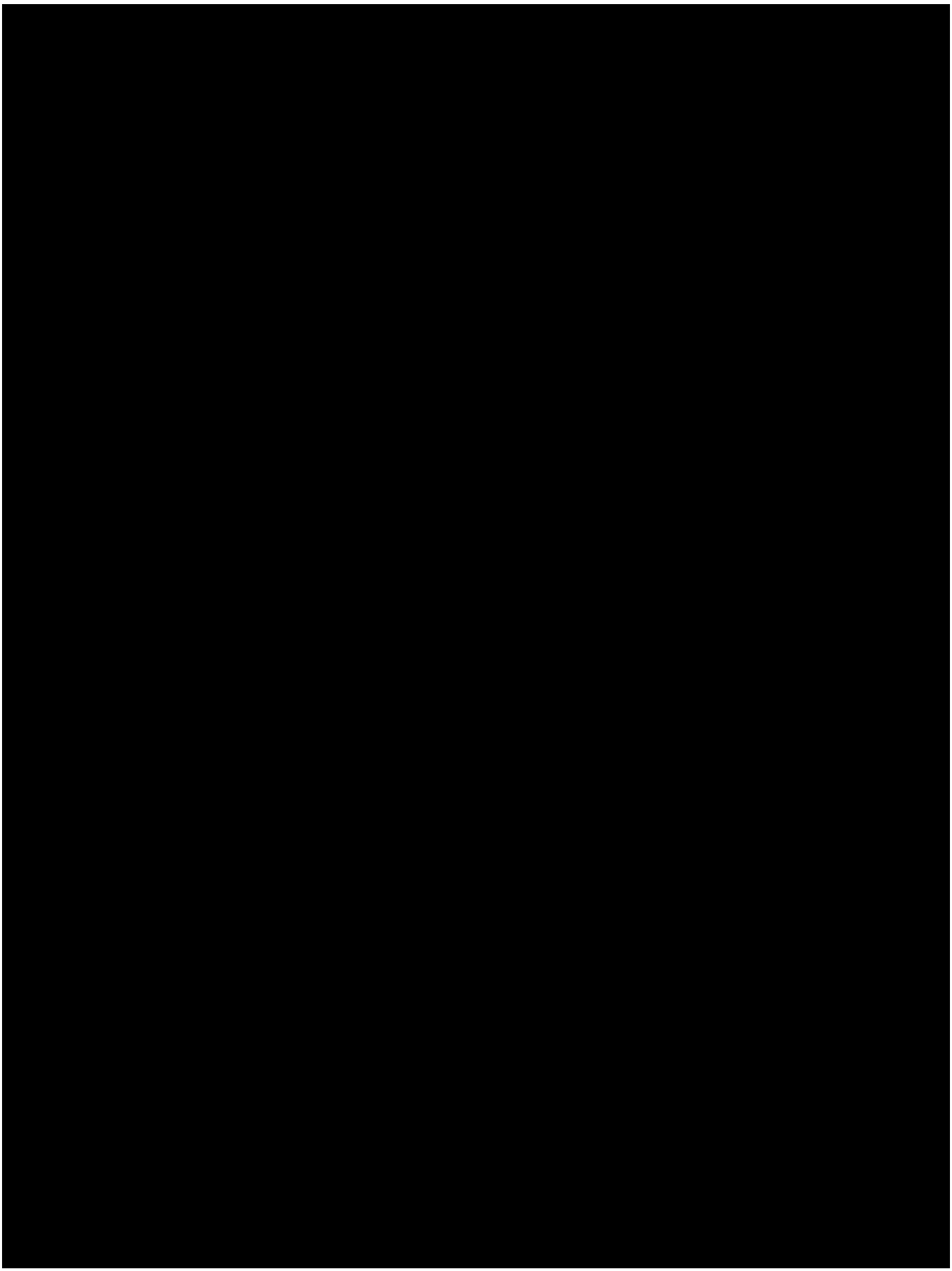
PS13714	PS13714 D10688 03052015 0743 hrs 13 182 55 Transmission 32631522 Kdy TG (C3)
PIRC-01178	PIRC-01178 - PIRC010515.367 Harry Kolberg's Dashcam footage
PIRC-01293	PIRC-01293 - PIRC010515.482 Infratech Compilation SD Card from Dashcam - Harry Kolberg Master Copy
PIRC-01287	PIRC-01287 - PIRC010515.476 Compilation QV1S4CHND 1 CCTV System Master Copy (Gallagher's)
PIRC-01289	PIRC-01289 - PIRC010515.478 Infratech Compilation 1 x Phone Gold Master Copy (Robson Kolberg iPhone)
PIRC-01285	PIRC-01285 - PIRC010515.474 CCTV from van driven by witness Grey
PIRC-03368	PIRC-03368 - Snapchat-289718241049293671
PIRC-03369	PIRC-03369 - Snapchat-2154007213033099882
PIRC-03370	PIRC-03370 - Snapchat-2800019487722441065
PIRC-03371	PIRC-03371 - Snapchat--4027412658762379031
PS00001	PS00001 D584 A388 14122020 C3 - 32630736 101 Call (C3)
PS00002	PS00002 D585 A388 14122020 C3 - 32630752 999 Call (C3)
PS00004	PS00004 D587 A388 14122020 C3 - 32630841 999 Call (C3)
PS00005	PS00005 D588 A388 14122020 C3 - 32630842 999 Call (C3)
PS00006	PS00006 D589 A388 14122020 C3 - 32630860 999 Call (C3)
PS00007	PS00007 D590 A388 14122020 C3 - 32632830 999 Call (C3)
PS00414	PS00414 D221 A369 04122020 Call from Joyce JOYCE 20150503-0745 0710hrs (SCD-MIT)
PIRC-01383	PIRC010515 572 Transcript of telephone call to Police 03 05 2015 Reference 20150503 Alan Pearson
PIRC-01385	PIRC010515 574 Transcript of telephone call to Police 03 05 2015 Reference 20150503 Harry Kolberg 1st Call
PIRC-01386	PIRC010515 575 Transcript of telephone call to Police 03 05 2015 Reference 20150503 Harry Kolberg 2nd Call
PIRC-01387	PIRC010515 576 Transcript of telephone call to Police 03 05 2015 Reference 20150503 Linda Limbert
PIRC-01388	PIRC010515 577 Transcript of telephone call to Police 03 05 2015 Reference 20150503 Joyce Joyce
PIRC-01441	PIRC010515 630 Transcript of telephone call to Police 03 05 2015 Reference 20150503 46433864 Simon Rowe

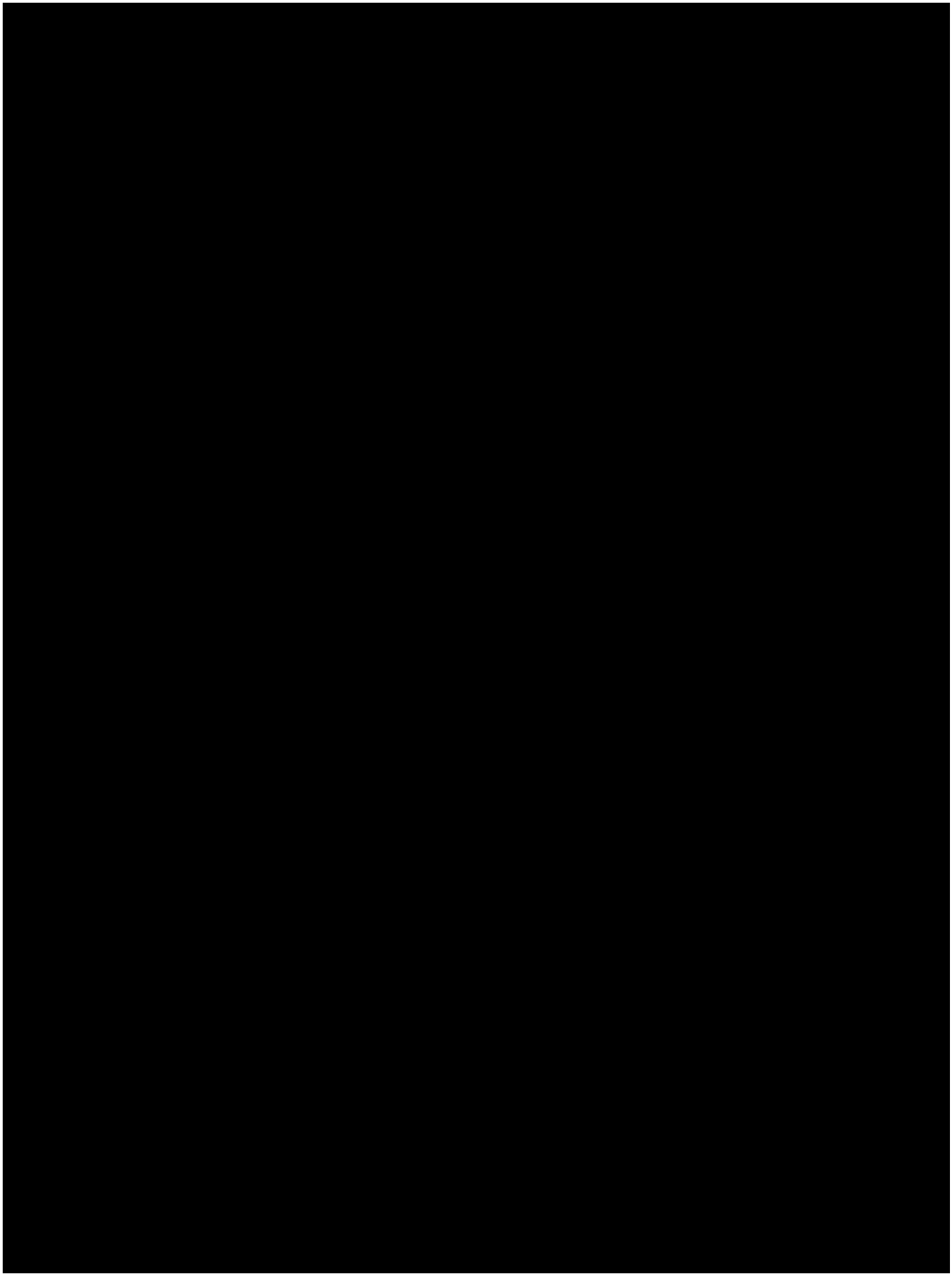
APPENDIX C - ALL MATERIAL RECEIVED

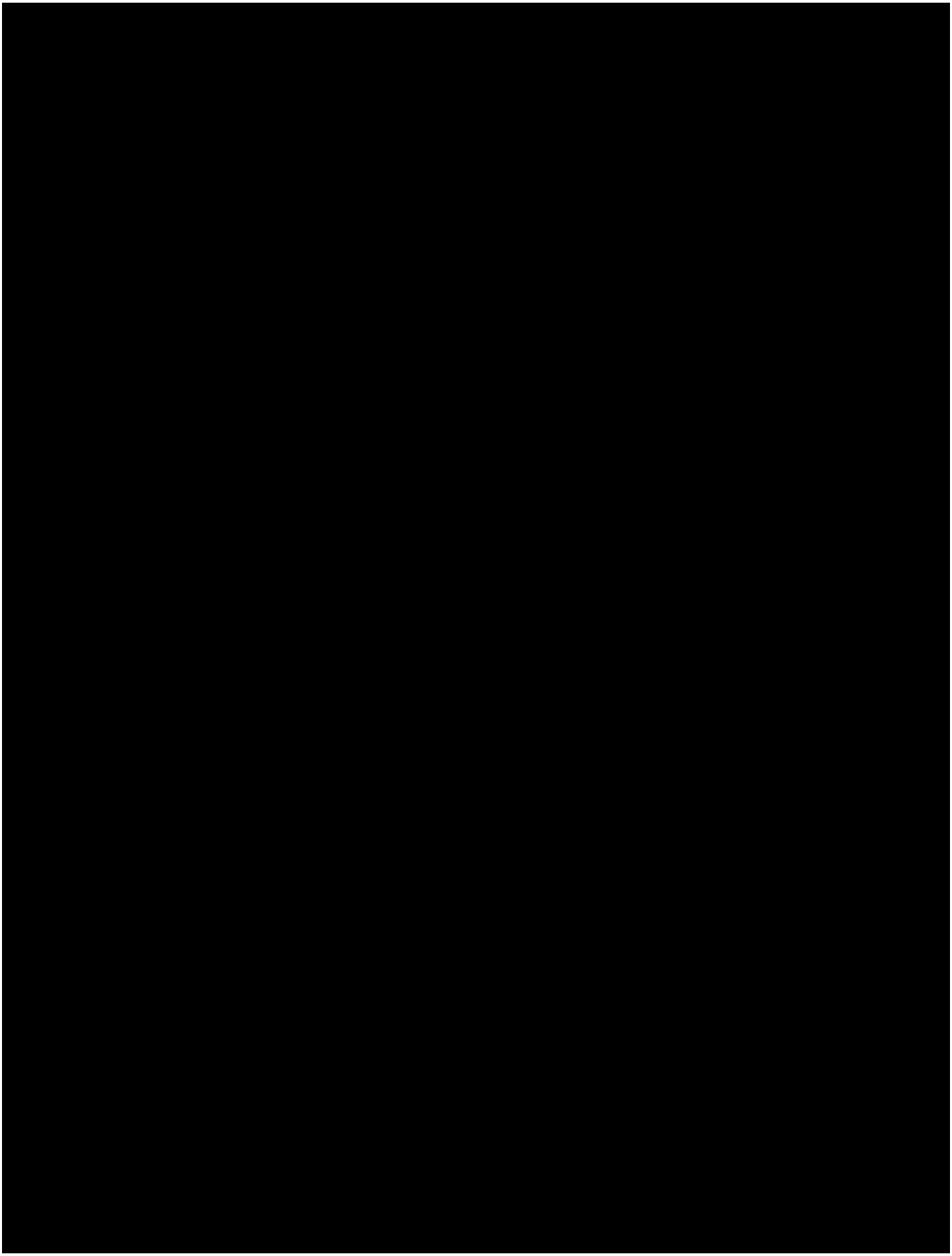


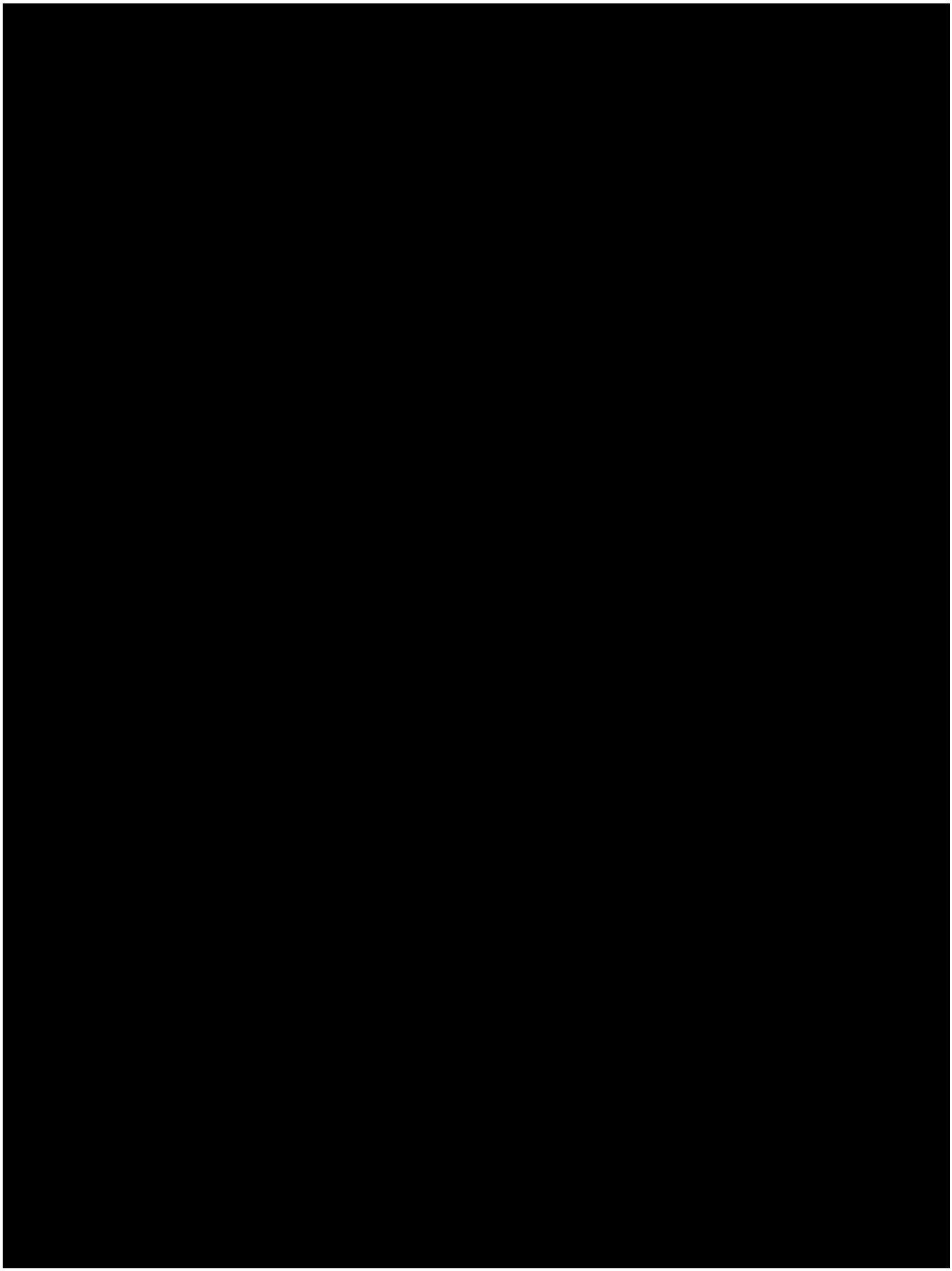


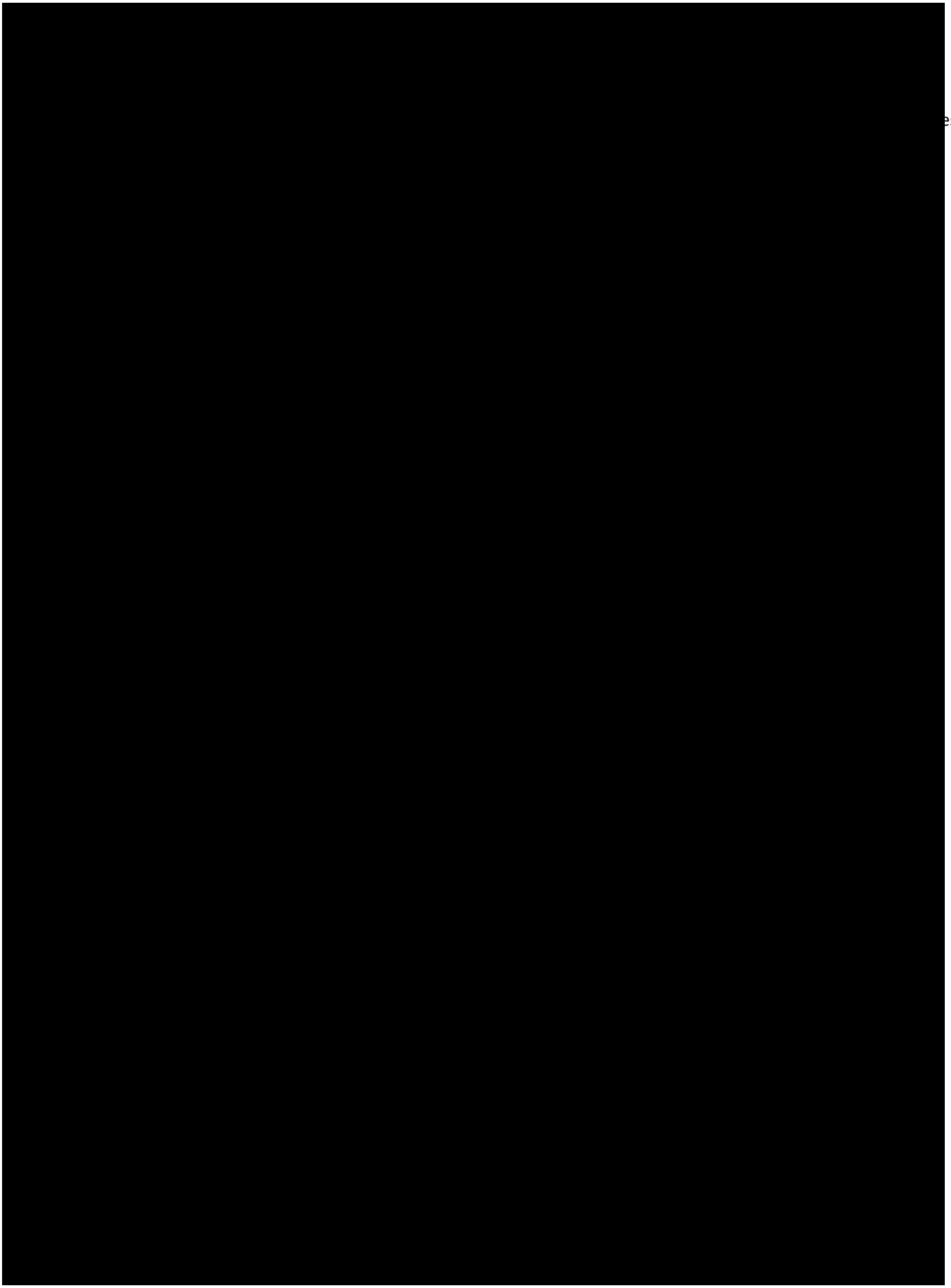




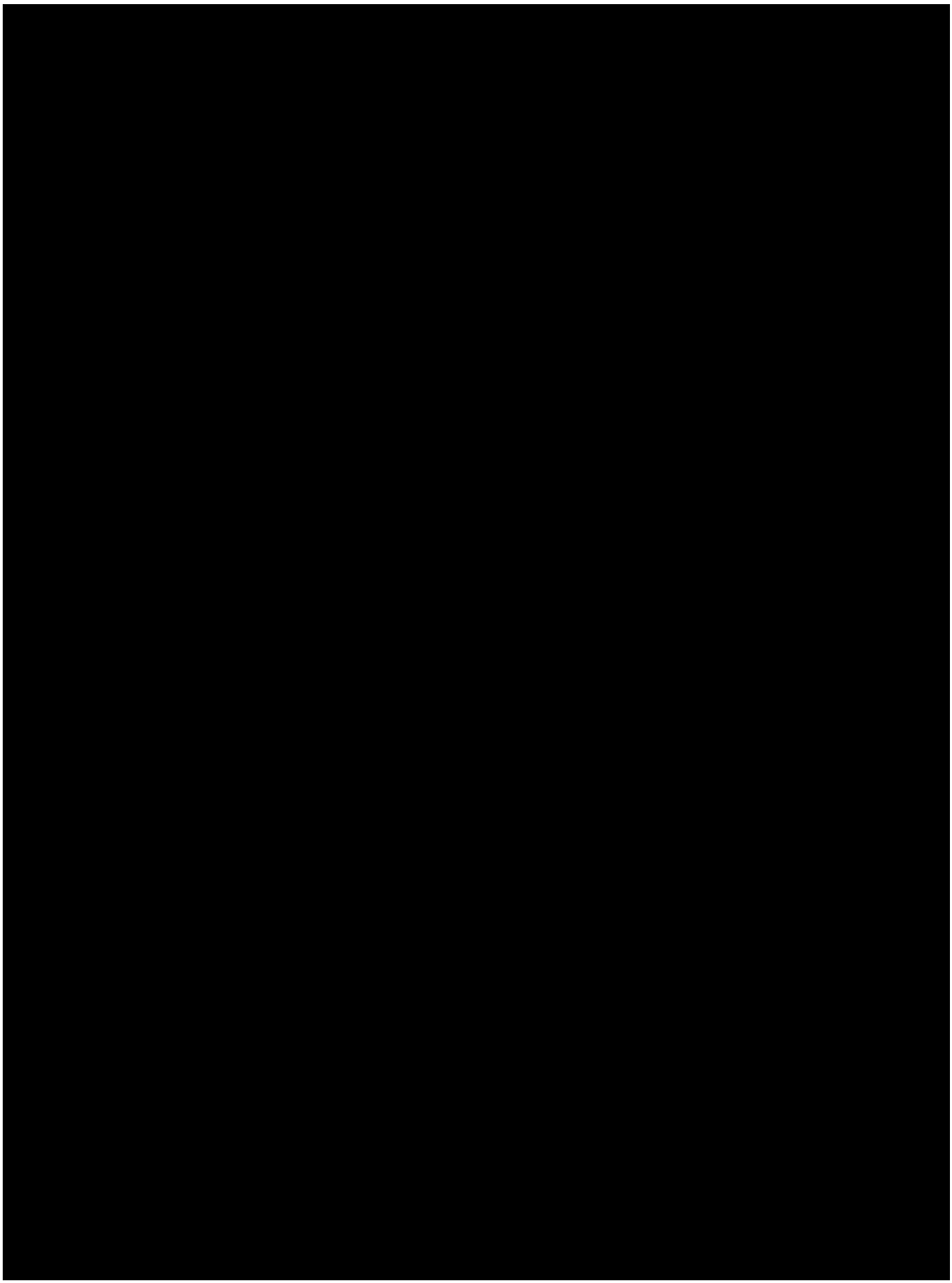


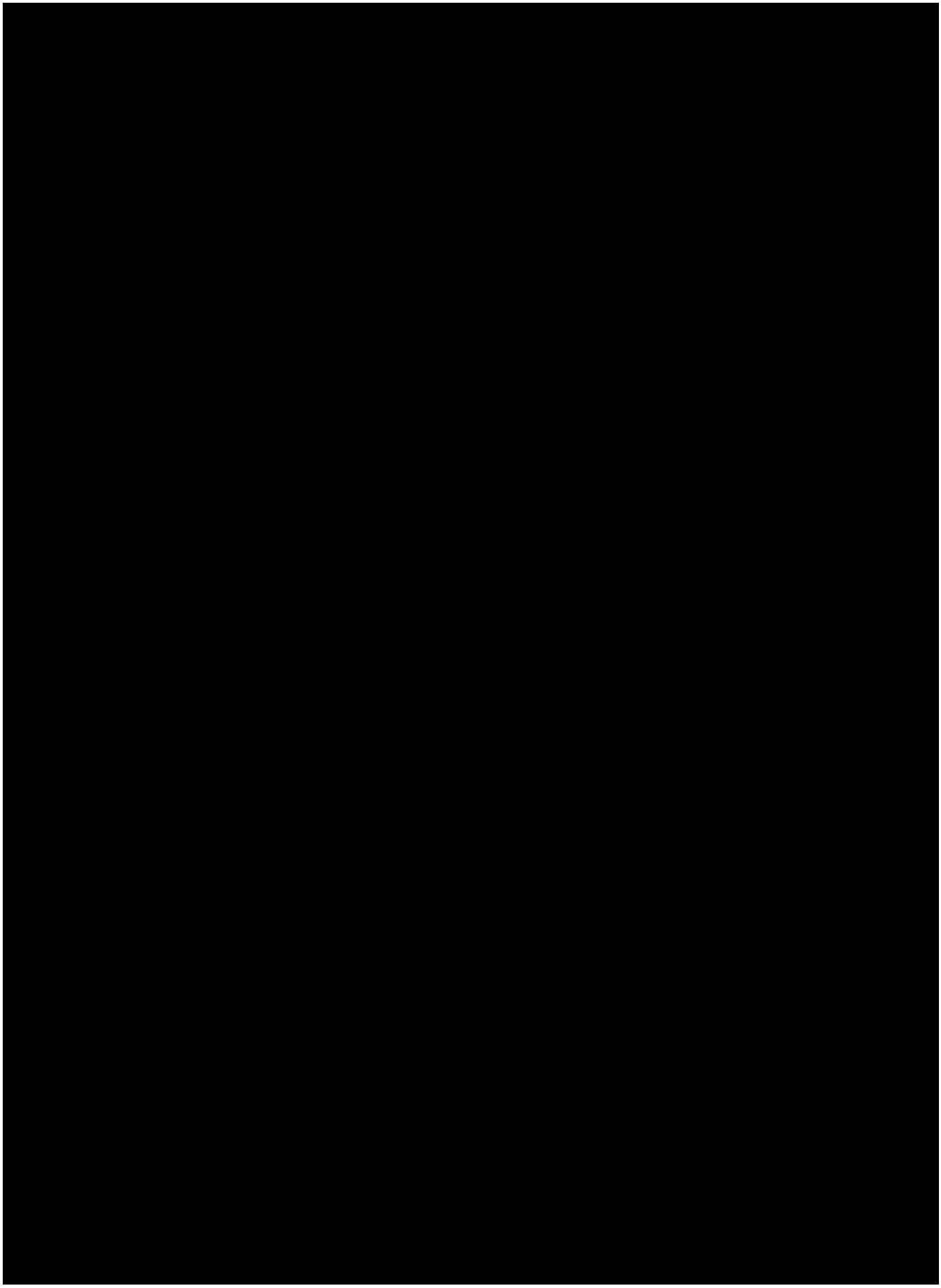






es containi





APPENDIX D - REGISTRATION REPORT

ADVANCED LASER IMAGING LTD

Leica Laserscan Registration Report

Prepared by: David Mercel, Chief Technical Officer

7 May 2022

On behalf of the Sheku Bayoh Inquiry

INTRODUCTION

1. TERMS OF REFERENCE

1.1. Laserscan Survey Data (Ref: PIRC-01155 - PIRC010515.344 Leica TruView 3D Scan) was supplied to ALI from the Sheku Bayoh Inquiry relating to a survey conducted using a Leica Laserscanner.

1.2. The survey had been conducted on the evening of 3rd March 2015 at 19:55hrs by PC's Paul MCANDREW and Adam WEIR from a Road Traffic Collision Unit of Police Scotland.

1.3. The data supplied encompassed the original unregistered survey data and a 'Truview' product that had processed data in the form of a panoramic tour.

1.4. It was required to register the original survey data to produce a 3D pointcloud of the scene that could be used for comparison and enhancement of a laserscan survey being conducted in late 2021.

2. SUPPLIED MATERIAL

2.1. The table below lists documents and other information supplied to Advanced Laser Imaging Ltd throughout the course of this project.

Identifier	Date Supplied	Description	Supplied by
PIRC-01155 - PIRC010515.344 Leica TruView 3D Scan.zip	15th Nov 2021	Zip file containing original survey data and Truview products.	Sheku Bayoh Inquiry Team

Table 1. Table listing supplied material

EXAMINATION & ANALYSIS

3. REGISTRATION

3.1. Leica Cyclone Register software was utilised to import the original survey data that was stored in a project (.prj) package under the folder labelled HAYFIELD RD KIRCALDY RAW DATA.

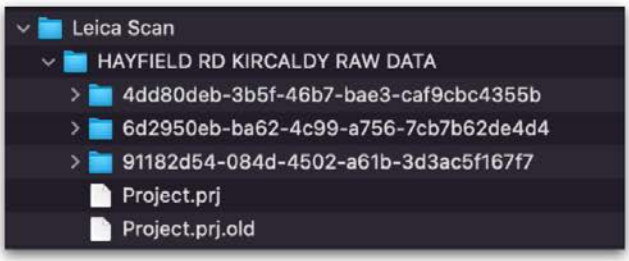


Image 1. Folder structure of original survey data

3.2. Settings used for the import of the data are shown in the image below.

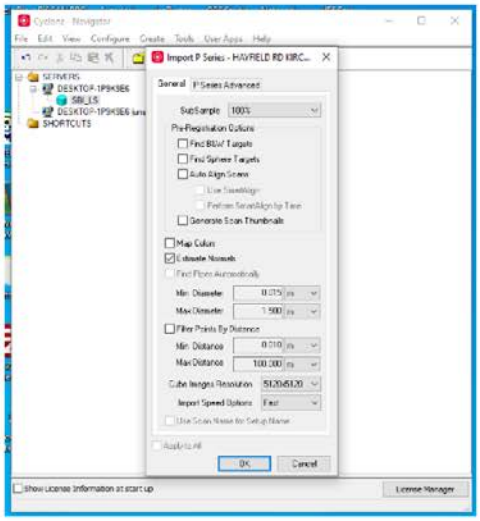


Image 2. Import settings

3.3. The import resulted in three scan positions being imported.

3.4. On inspection of the 3D Views it was apparent that 3 scan targets had been placed into the scene to aid in registration.

3.5. Additional constraints using 'Cloud to Cloud' which uses overlap of adjacent scan positions were also added to the registration.

3.6. This resulted in 10 constraints being listed within the registration.

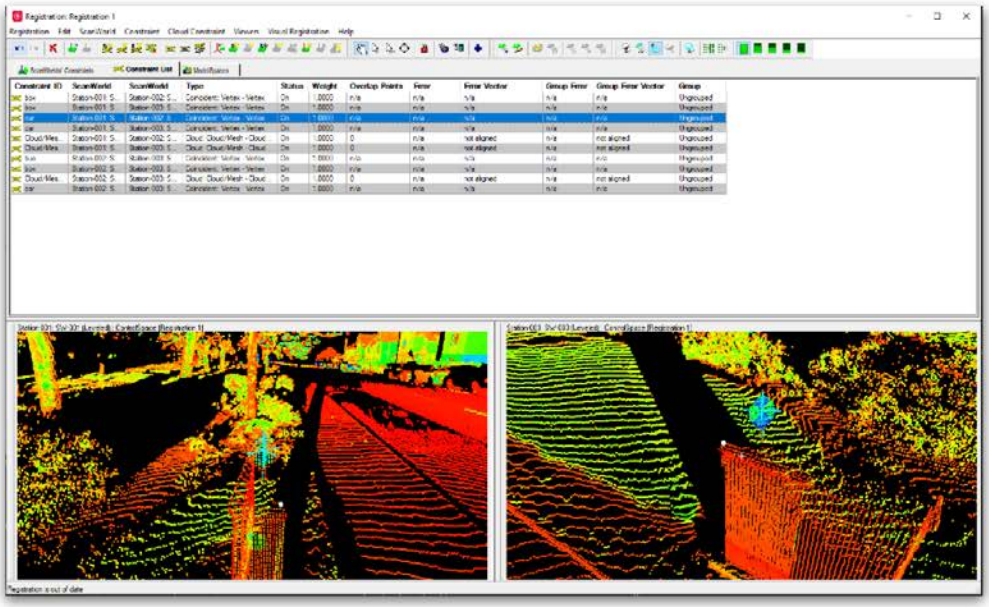


Image 3. Constraints added to the Registration

3.7. The registration calculation was applied and resulted in a high accuracy across all constraints, with max RMS error of 2mm.

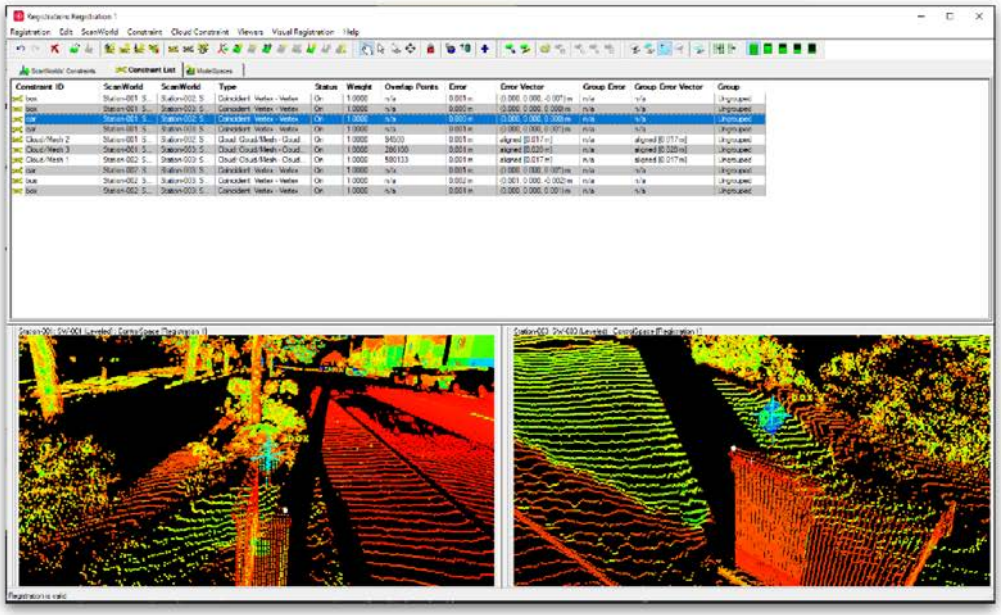


Image 4. Registration constraint results after registration calculation

3.8. Further results from the registration can be viewed in the registration report in Appendix A.

3.9. A new scanworld was created from the registration that encompassed all three registered survey positions.

3.10. The registered scanworld was opened and visually inspected to ensure reliable results from the registration as it can be the case that the registration report produces accurate numbers but the resulting alignment is incorrect or inaccurate.

3.11. The visual inspection verified that the alignment of the three scan positions was of good quality and no issues were identified.

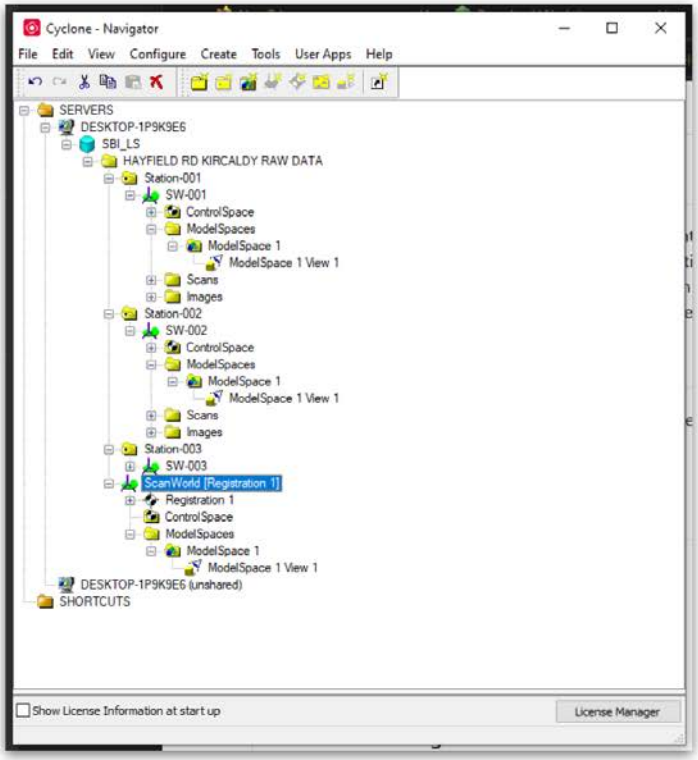


Image 5. Final project folder structure showing Registration ScanWorld

4. DATA EXPORT

4.1. In order that the data for each registered scan could be utilised with the new laser scan survey the data was exported from Leica Cyclone Register.

4.2. Each scan was exported as .PTX and .E57 file formats to ensure that they could be imported into third party software.

4.3. The .E57 file format has become more of a standard in recent years but each software vendor's implementation of the specification varies and sometimes there are issues importing files.

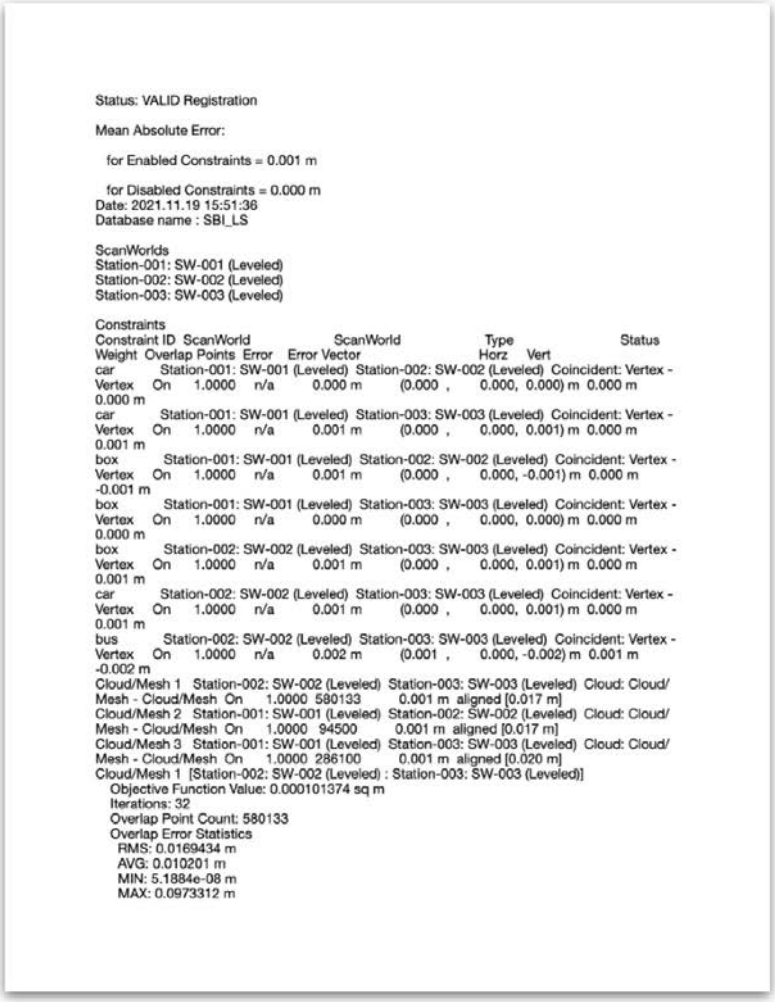
4.4. Therefore, the .PTX format files were also exported as this is a 'human readable' text format that contains all the necessary information to reconstruct each scan if required.

4.5. The exported files were issued to Mr Mark DeGiovanni at ALI for further utilisation.

APPENDICES

APPENDIX A

Registration Report



Status: VALID Registration

Mean Absolute Error:

for Enabled Constraints = 0.001 m

for Disabled Constraints = 0.000 m
Date: 2021.11.19 15:51:36
Database name : SBI_LS

ScanWorlds
Station-001: SW-001 (Leveled)
Station-002: SW-002 (Leveled)
Station-003: SW-003 (Leveled)

Constraints
Constraint ID ScanWorld ScanWorld Type Status
Weight Overlap Points Error Error Vector Horz Vert
car Station-001: SW-001 (Leveled) Station-002: SW-002 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.000 m (0.000 , 0.000, 0.000) m 0.000 m
0.000 m
car Station-001: SW-001 (Leveled) Station-003: SW-003 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.001 m (0.000 , 0.000, 0.001) m 0.000 m
0.001 m
box Station-001: SW-001 (Leveled) Station-002: SW-002 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.001 m (0.000 , 0.000, -0.001) m 0.000 m
-0.001 m
box Station-001: SW-001 (Leveled) Station-003: SW-003 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.000 m (0.000 , 0.000, 0.000) m 0.000 m
0.000 m
box Station-002: SW-002 (Leveled) Station-003: SW-003 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.001 m (0.000 , 0.000, 0.001) m 0.000 m
0.001 m
car Station-002: SW-002 (Leveled) Station-003: SW-003 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.001 m (0.000 , 0.000, 0.001) m 0.000 m
0.001 m
bus Station-002: SW-002 (Leveled) Station-003: SW-003 (Leveled) Coincident: Vertex -
Vertex On 1.0000 n/a 0.002 m (0.001 , 0.000, -0.002) m 0.001 m
-0.002 m
Cloud/Mesh 1 Station-002: SW-002 (Leveled) Station-003: SW-003 (Leveled) Cloud: Cloud/
Mesh - Cloud/Mesh On 1.0000 580133 0.001 m aligned [0.017 m]
Cloud/Mesh 2 Station-001: SW-001 (Leveled) Station-002: SW-002 (Leveled) Cloud: Cloud/
Mesh - Cloud/Mesh On 1.0000 94500 0.001 m aligned [0.017 m]
Cloud/Mesh 3 Station-001: SW-001 (Leveled) Station-003: SW-003 (Leveled) Cloud: Cloud/
Mesh - Cloud/Mesh On 1.0000 286100 0.001 m aligned [0.020 m]
Cloud/Mesh 1 [Station-002: SW-002 (Leveled) : Station-003: SW-003 (Leveled)]
Objective Function Value: 0.000101374 sq m
Iterations: 32
Overlap Point Count: 580133
Overlap Error Statistics
RMS: 0.0169434 m
AVG: 0.010201 m
MIN: 5.1884e-08 m
MAX: 0.0973312 m

Overlap Center: (0.514, -5.534, 2.079) m
Error after global registration: 3.27859e-07 sq m
Translation: (15.352, -11.725, 0.410) m
Rotation: (0.0000, 0.0000, 1.0000):-131.913 deg
Cloud/Mesh 2 [Station-001: SW-001 (Leveled) : Station-002: SW-002 (Leveled)]
Objective Function Value: 0.000120817 sq m
Iterations: 40
Overlap Point Count: 94500
Overlap Error Statistics
RMS: 0.0168596 m
AVG: 0.0102352 m
MIN: 2.06631e-06 m
MAX: 0.0902467 m
Overlap Center: (-20.408, 37.502, 1.452) m
Error after global registration: 8.59725e-07 sq m
Translation: (-40.920, 40.544, -1.055) m
Rotation: (0.0001, 0.0000, -1.0000):-31.536 deg
Cloud/Mesh 3 [Station-001: SW-001 (Leveled) : Station-003: SW-003 (Leveled)]
Objective Function Value: 0.000140784 sq m
Iterations: 34
Overlap Point Count: 286100
Overlap Error Statistics
RMS: 0.0195007 m
AVG: 0.0122192 m
MIN: 1.22479e-06 m
MAX: 0.0972042 m
Overlap Center: (-15.461, 30.491, 1.722) m
Error after global registration: 9.94562e-07 sq m
Translation: (-21.704, 38.580, -0.645) m
Rotation: (0.0001, 0.0000, 1.0000):-100.378 deg

ScanWorld Transformations
Station-001: SW-001 (Leveled)
translation: (0.000, 0.000, 0.000) m
rotation: (0.0000, 1.0000, 0.0000):0.000 deg

Station-002: SW-002 (Leveled)
translation: (-40.921, 40.544, -1.055) m
rotation: (0.0000, 0.0000, 1.0000):31.535 deg

Station-003: SW-003 (Leveled)
translation: (-21.705, 38.581, -0.646) m
rotation: (-0.0000, -0.0000, -1.0000):100.378 deg

Unused ControlSpace Objects
Station-001: SW-001 (Leveled):
Vertex : unlabeled
Vertex : TargetID : post

Station-002: SW-002 (Leveled):
Vertex : unlabeled

Station-003: SW-003 (Leveled):
Vertex : unlabeled

APPENDIX E - CALIBRATION CERTIFICATES

Calibration Certificate

Model: Focus S 150 Serial Number: LLS081813233 Certificate Number: LLS13233-20211021-CS Certification Date: 21-Oct-2021

Measurement Items Used, Traceable to National Standards

Laser Tracker

Model: Vantage	Serial No.: V01001506577	Cert. No.: V05577-23062021	Cert. Date: 23-Jun-2021

Reflectance Targets at 10m Distance

Model: Spectralon Target 90%	Serial No.: CTE1081	Cert. No.: 21011805	Cert. Date: 18.01.2021
Model: Spectralon Target 10%	Serial No.: CTE1080	Cert. No.: 21011806	Cert. Date: 18.01.2021
Model: AcktarMagicBlack 2%	Serial No.: CTE1078	Cert. No.: 21011806	Cert. Date: 18.01.2021

Calibration Results

3D Position Accuracy

Target 1	Target 2	Zone	Distance [m]	Uncertainty, k=2 [mm]	Scanner [m]	Deviation [mm]	Spec., k=1 [mm]	Spec., k=2 [mm]	Result
ZK62	ZK63	10 m	4.00224	0.20	4.00218	-0.06	1.5	2.0	pass
ZK62	ZK61	10 m	1.45259	0.20	1.45262	0.03	1.5	2.0	pass
ZK63	ZK64	25 m	12.45056	0.20	12.45123	0.67	1.5	2.0	pass

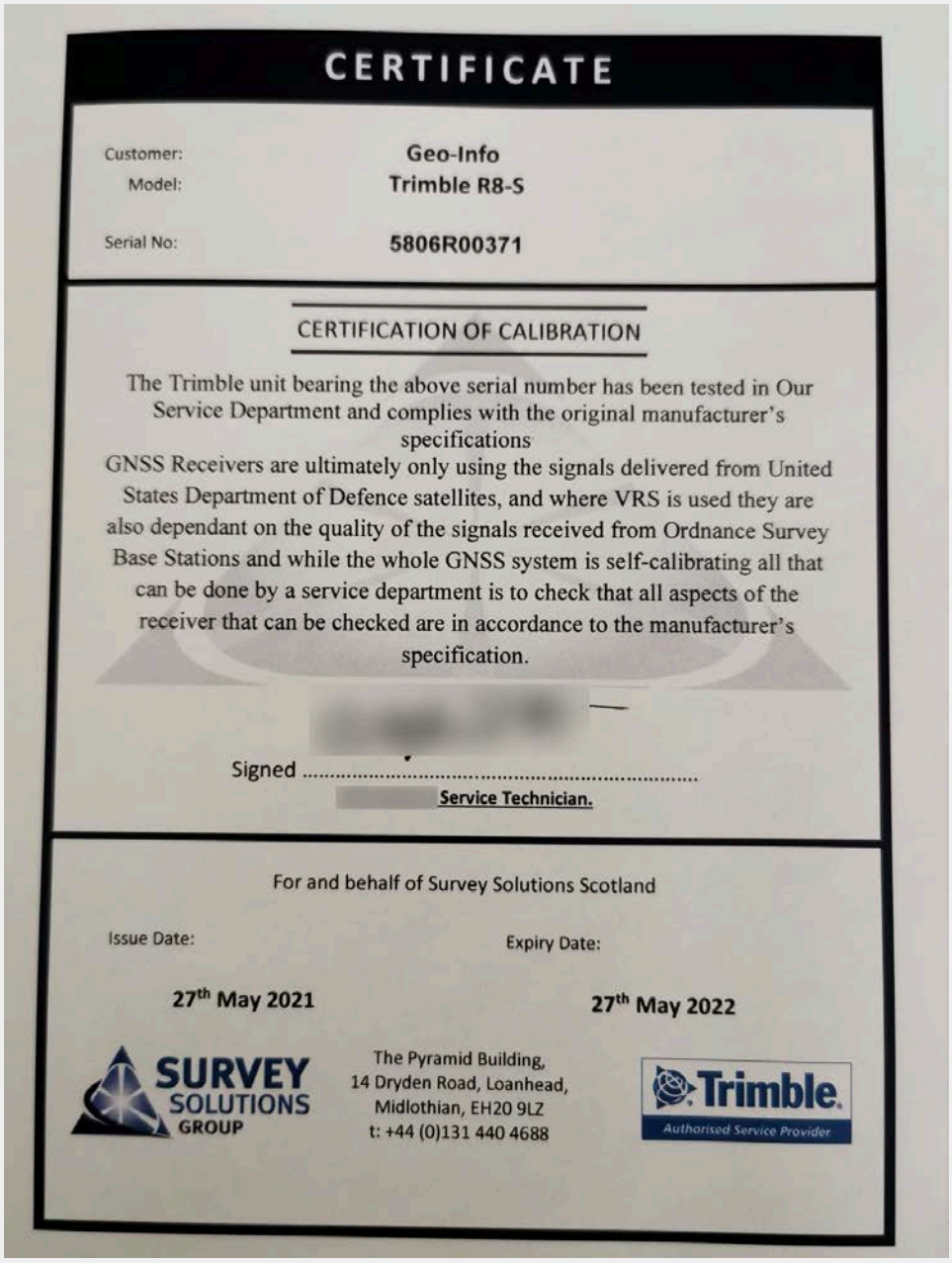
Ranging Noise

Reflectance	Distance	Uncertainty, k=1 [mm]	Scanner	Specifications	Result
90%	10 m	0.067	0.14	0.30	pass
	25 m	0.067	0.15	0.30	pass
10%	10 m	0.067	0.20	0.40	pass
	25 m	0.067	0.28	0.50	pass
2%	10 m	0.067	0.38	1.30	pass
	25 m	0.067	0.63	2.00	pass

The results of this certificate relate only to the items calibrated or tested.
The calibration is done at FARO or FARO Scanner Production operations sites according to FARO test protocols integrating guidelines defined in the Joint Committee for Guides in Metrology guidance document JCGM 100:2008 - Evaluation of measurement data - Guide to the expression of uncertainty in measurement, and the requirements for traceability according to the International Vocabulary of Basic and General Terms in Metrology (VIM) and the National Institute of Standards and Technology (NIST).

Authorization: ____________ Calibration Technician Date: 21-Oct-2021

FARO®



CERTIFICATE

Customer: Geo-Info
Model: Trimble R8-S

Serial No: 5806R00371

CERTIFICATION OF CALIBRATION

The Trimble unit bearing the above serial number has been tested in Our Service Department and complies with the original manufacturer's specifications
GNSS Receivers are ultimately only using the signals delivered from United States Department of Defence satellites, and where VRS is used they are also dependant on the quality of the signals received from Ordnance Survey Base Stations and while the whole GNSS system is self-calibrating all that can be done by a service department is to check that all aspects of the receiver that can be checked are in accordance to the manufacturer's specification.

Signed .....
Service Technician.

For and behalf of Survey Solutions Scotland

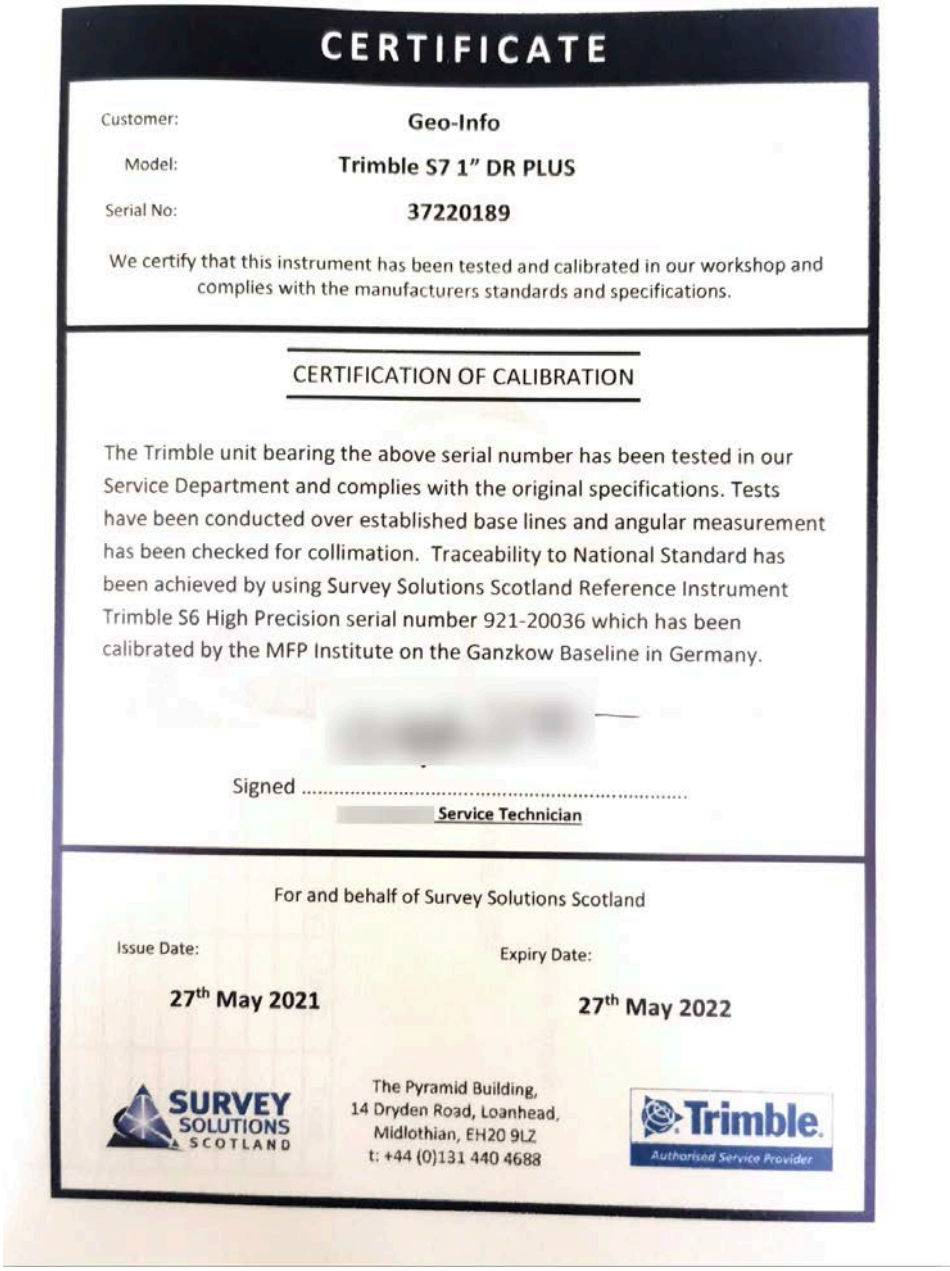
Issue Date: 27th May 2021

Expiry Date: 27th May 2022

SURVEY SOLUTIONS GROUP

The Pyramid Building,
14 Dryden Road, Loanhead,
Midlothian, EH20 9LZ
t: +44 (0)131 440 4688

Trimble
Authorised Service Provider



CERTIFICATE

Customer: **Geo-Info**

Model: **Trimble S7 1" DR PLUS**

Serial No: **37220189**

We certify that this instrument has been tested and calibrated in our workshop and complies with the manufacturers standards and specifications.

CERTIFICATION OF CALIBRATION

The Trimble unit bearing the above serial number has been tested in our Service Department and complies with the original specifications. Tests have been conducted over established base lines and angular measurement has been checked for collimation. Traceability to National Standard has been achieved by using Survey Solutions Scotland Reference Instrument Trimble S6 High Precision serial number 921-20036 which has been calibrated by the MFP Institute on the Ganzkow Baseline in Germany.

Signed .....

Service Technician

For and behalf of Survey Solutions Scotland

Issue Date: **27th May 2021**

Expiry Date: **27th May 2022**

SURVEY SOLUTIONS SCOTLAND

The Pyramid Building,
14 Dryden Road, Loanhead,
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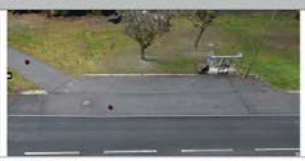
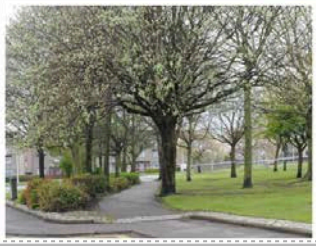
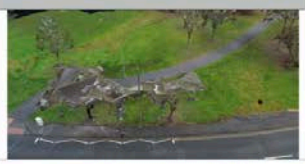
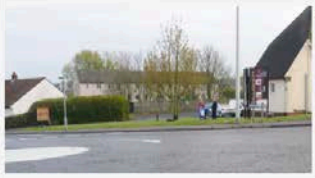
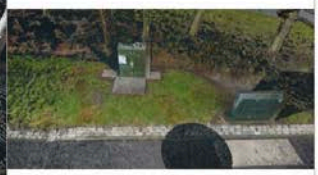
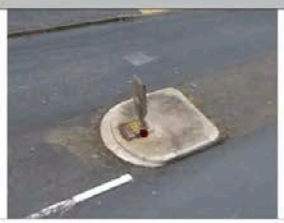
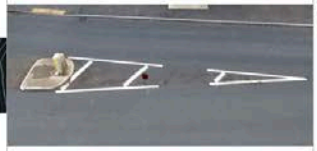
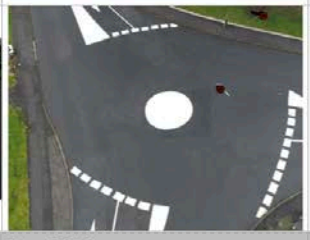
Trimble. Authorised Service Provider

APPENDIX F -SCENE VARIATIONS

Reference	May 2015	Dec 2021	Description
A1			Road layout change, bus stop lay-by removed.
A2			Bus Stop bin added
A3			Path onto Hayfield Avenue has been remodelled. Several trees have been cut and the path diverts further away from the road.

Reference	May 2015	Dec 2021	Description
A4			Path diverted on Hendry Road to the traffic lights, Old path still visible in 2021 survey.
A5			Planter added to grass area
A6			Wooden fence has been erected and sign near car park removed.
A7			2015 telecom box has been changed and is larger, a second telecoms box has been installed next to it.

Reference	May 2015	Dec 2021	Description
A8			Sign has been repaired
A9			Lines have been repainted, newer version has cross hatching.
A10			Cycle Lanes Removed
A11			Painted arrows on roundabout worn away/removed
Reference	**May 2015**	**Dec 2021**	**Description**
A12			Gallagher's Pub now renamed to 'The White Heather', some exterior decoration, but structure appears to be unchanged. CCTV camera has been removed.

APPENDIX G - METHODOLOGY

ADVANCED LASER IMAGING LTD

STATEMENT ANALYSIS METHODOLOGY

1. TERMS OF REFERENCE

1.1. It is common for investigations to have a variety of statemental evidence from different sources, such as witnesses and experts, that need to be considered as part of a Digital Reconstruction.

1.2. Given the nature of statements, they can be subjective and usually convey a specific person's point of view or opinion on events that have occurred during an incident or analysis. They can contain quantitative and qualitative descriptions.

1.3. For the purposes of reconstruction it may be important to extract relevant information from a statement that can be utilised to produce a 'version' of events. This 'version' will be subjective in nature by the very fact that it has originated from a subjective source material.

1.4. The types of information that are relevant to a reconstruction are detailed below and where possible can be extracted from the statemental evidence for utilisation in the reconstruction.

1.5. It is important, where possible, to cross reference subjective information with other available factual and more objective information to 'calibrate' it to known and/or less disputed information and to provide a consistent approach to assessing the subjective information across numerous statements.

2. TYPES OF INFORMATION RELEVANT TO RECONSTRUCTION

Temporal

2.1. Temporal information describes discreet or relative timings of events.

2.2. These can be in the form of exact times stated, or more commonly approximate timings recalled by an individual.

2.3. It may also be the case that the statement describes a chronology of events that can be correlated to other separate information that can then help to derive a time, for example a loud noise is heard by a witness that has also been recorded on a video or other device at the same location.

2.4. Where possible, statements should be analysed against an objective timeline that can be corroborated through other sources. Good examples are reliably timed CCTV footage or audio recordings.

Spatial

2.5. Spatial information relates to the location of events, persons or objects of interest.

2.6. Spatial information can consist of direct measurement data perhaps recorded by someone with a measurement tape or other measurement device.

2.7. More commonly the spatial information is expressed as 'relative' position of people or objects within a scene. For example, a person is described as standing next to another person or object.

2.8. It is highly recommended to gather additional accurate measurement information about a scene or location in order to reference 'known' positions of 'permanent' objects, such as street furniture, buildings or large natural features. Depending on the time of the original incident these may have also changed so additional research and analysis may need to be conducted, however, by utilising the known positions of objects in an accurately measured scene the positions described by the statemental evidence can be more reliably interpreted.

Identification of Persons

2.9. Statements often describe people involved in an incident that may aid identification.

2.10. Relevant information may include, names, physical descriptions (sex, height, build, weight, skin colour, eye colour, hair colour or style), clothing (colour, style, make or texture of clothing worn), personal distinguishing markings (scars, tattoos, mole patterns, injuries), demeanour (style of walking, way of carrying themselves or pattern of behaviour), voice (audible tone, style of speech, language spoken).

2.11. It may also include accessories or objects worn or carried by an individual, such as jewellery, weapons, devices or other objects.

2.12. It is important to validate this information, where possible, against 'known' persons involved in the incident as elucidated by CCTV, Imagery, Video and other factual evidence.

Identification of Objects

2.13. There are often certain objects of importance that are described by statemental evidence.

2.14. Relevant information may include size or dimensions, type, colour, method of use, serial numbers, weights, textures, patterning, emitted light or contaminants.

2.15. Additionally a statement may make comparisons of objects to other reference objects. An example would be comparison of a jacket to a similar jacket owned by the person giving the statement. In these cases additional information may need to be gathered about the reference object.

2.16. It is important, where possible, to validate descriptions against 'known' objects that have been recorded for an incident and photographed or videoed in situ or by expert means. Additionally, if access is possible to the objects they can be surveyed and measured to provide further evidential information and validation.

The above types of information are not intended to be exhaustive and due to the complexity and changing nature of investigations, for example digital forensics, there may be additional information that is required that is relevant to the context of the investigation and should be incorporated where necessary.

APPENDIX H - PUBLIC STATEMENT ANALYSIS

ADVANCED LASER IMAGING LTD

Public Statement Analysis Report

Prepared by: David Mercel, Chief Technical Officer

7 May 2022

On behalf of the Sheku Bayoh Inquiry

SHEKU BAYOH INQUIRY

INTRODUCTION

1. TERMS OF REFERENCE

1.1. During the temporal analysis of the Public statements for the Sheku Bayoh Inquiry, it was necessary to review the Evidence Video Timeline in detail to establish the most likely vehicles being driven by particular witnesses that were describing events.

1.2. To make the identification, frames of the video were captured and compared against reference images of the vehicle types described by the witness.

1.3. Additionally consideration was made of the size and colour of the vehicle in relation to the time that such a vehicle was observed within the footage and its relationship to other events taking place within the scene.

1.4. This report describes the analysis conducted for each required witness and the conclusions of that analysis.

2. REFERENCED MATERIAL

2.1. The table below lists files, documents and other information used in this analysis.

Identifier	Date Supplied	Description	Supplied by
Video and Audio overlay_c.mp4	7th Jan 2022	Evidence Video Timeline (SBPI-00046)	Mark DeGiovanni - ALI
PIRC-00075 - S044 Abdeloouhab GUESSOUM copy.pdf	8th Oct 2021	Witness Statement from Abdeloouhab GUESSOUM	Sheku Bayoh Inquiry
PIRC-00120 - S082 Sean MULLEN copy.pdf	8th Oct 2021	Witness Statement from Sean MULLEN	Sheku Bayoh Inquiry

Table 1. Table listing used material

EXAMINATION & ANALYSIS

3. STATEMENT OF ABDELOOUHAB GUESSOUM

3.1. In the statement made by Abdeloouhab GUESSOUM it is stated that he is driving a black Renault Megane and that he was travelling on Hendry Road with Hayfield Road on his right hand side.

3.2. This is given by the following extracts from the statement:

- 'I drive a Renault Megane (black)'
- 'I was driving along Hendry Road and Hayfield Road was on my right hand side.'

3.3. Given this description it can be assumed that the vehicle being driven is travelling North on Hendry Road in order to have Hayfield Road on the right hand side.

3.4. In order to establish a set of possible vehicles that may match this description a source image of a black Renault Megane of the same year (2000) was sourced from https://bestcarmagz.net/gallery/2000-renault-megane/page/2

Image 1. Reference image of Renault Megane

3.5. There were two possible dark coloured vehicles identified that enter the scene in the manner described by the witness and have a similar resemblance to the reference image in terms of colour and size.

3.6. A frame was captured from the video for each of these possible vehicles. The first recorded at 07.22.45 and the second at 07.27.08.

Image 2. Frame captured at 07.22.45

Image 3. Frame Captured at 07.27.08

3.7. The captured frames were further visually compared to the reference image, this time with particular attention to the body styling features of the vehicle. It was observed that the vehicle captured at 07.27.08 appeared to have more rounded rear quarter features that were considered to match the features of the reference image more closely.

3.8. Additionally, in further review of the video at these times, the vehicle captured at 07.22.45 turns into Hayfield Road and passes the location where the intervention is taking place. The vehicle captured at 07.27.08 continues up Hendry Road and does not turn into Hayfield Road.

3.9. The statement does not clearly state whether the vehicle turns into Hayfield Road, however, there is reference to turning into 'Telpole Avenue'. This is made in the part of the statement that reads 'I decided not to go to work so I turned into Telpole Avenue and went straight home'.

3.10. It has been considered that this may actually be referring to 'Templehall Avenue' that is further up Henry Road. It may be that the transcript of the statement has recorded the spelling of this incorrectly.

4. STATEMENT OF SEAN MULLEN

4.1. The statement from Sean MULLEN describes the events unfolding in some detail when first at the scene. This made identification of the vehicle relatively straight forwards. However, they describe leaving the scene and then returning again which added some complication to temporal placement of the return.

4.2. It is stated that the vehicle being driven is a Silver Vauxhall Astra as stated in the sentence 'silver Vauxhall Astra motor vehicle'.

4.3. The vehicle identified as belonging to Sean MULLEN leaves the scene at 07.22.10.

Image 4. Frame captured at 07.22.02

4.4. A screen capture was made of the video just prior to this in order to have a reference image to compare future vehicles entering the scene.

4.5. Further screen captures were performed after reviewing the video to identify possible similar vehicles entering the scene again. These observations were made at 07.24.18, 07.27.43 and 07.28.19.

Image 5. Frame captured at 07.24.18

Image 6. Frame captured at 07.27.43

Image 7. Frame captured at 07.28.19

4.6. It is referenced in the statement that the scene was left and there is some time that elapses before returning to the scene again. This is detailed in the following extracts from the statement.

- 'At this point I decided to drive away and I didn't see what happened next. I turned left and took Daniel [redacted]. We spoke in his car for about 2 to 3 minutes about what had happened before he got out [redacted].'
- 'I drove the car back up towards the roundabout, at Hayfield Road. There was a police woman diverting traffic away from Hayfield Road which had been closed off.'
- 'I drove up the next roundabout at the Hub Garage, went round it and drove back towards the Hayfield Road roundabout. I didn't stop but was going slowly to see what was happening. There were police cars parked across Hayfield Road.'

4.7. Given the vehicle leaves the scene at 07.22.10, it is perhaps unlikely that the journey could have been made [redacted], a 2-3 minute conversation taken place and then a return to the scene made before the vehicle at 07.24.18 arrives. It may be that the recollection of the length of the conversation is incorrect, but it still does not leave much time for the journey to be made.

4.8. The remaining vehicle reference that is travelling North on Hendry Road is observed at 07.27.43 and gives a more reasonable time period for the journey to have been made [redacted]

4.9. That leaves the last reference at 07.28.19 where the vehicle is travelling South on Hendry Road. This appears to correlate well with the description made in the statement of going round the 'Hub Garage' roundabout and travelling back towards the roundabout at Hayfield Road.

4.10. Additional evidence that supports the later time frame for the return to the scene, is that the intervention had entered a later stage by this point and Hayfield Road was starting to be blocked off to traffic, which is referenced in the statement as well.

CONCLUSIONS

5. TEMPORAL PLACEMENT FOR ABDELOOUHAB GUESSOUM

5.1. Positioning this statement has been difficult due to conflicting and incomplete information in the statement.

5.2. The statement has been placed at 07.27.04 due to the vehicle observed appearing to match the reference image more closely and the description of the path taken into 'Telpole Avenue', that is likely Templehall Avenue that branches from further up Hendry Road, matching the path of the vehicle that continues on Hendry Road.

5.3. It is notable that the vehicle observed at 07.22.45 does turn into Hayfield Road and may have had a longer view of the intervention taking place, but its movements do not as closely match the details given in the statement.

6. TEMPORAL PLACEMENT FOR SEAN MULLEN

6.1. Given the correlations with the later timeframe for Sean MULLEN's return to the scene the temporal placement for the return to the scene has been made for 07.27.43 and 07.28.19 respectively, as he returns to the scene, exits and then returns a second time.

6.2. It is considered unlikely that the journey to deliver the passenger [redacted] could have been made quickly enough to be the vehicle that is observed at 07.24.18, especially given that the statement refers to a conversation of 2-3 minutes taking place upon arrival [redacted].